DRAFT
Remedial Action Management Plan
Thermal Remediation Pilot Study

Soil and Groundwater Operable Units

Wyckoff/Eagle Harbor Superfund Site
Bainbridge Island, Washington

Prepared by
Department of the Army
U. S. Army Corps of Engineers
Seattle District

and

SCS Engineers, Inc.
Bellevue, Washington

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1.0 INTRODUCTION

The U.S. Army Corps of Engineers (USACE) is providing remedial design and remedial action services for the U.S. Environmental Protection Agency (EPA) Region 10 for the Wyckoff/Eagle Harbor Superfund Site, located on Bainbridge Island, Washington. USACE has designed a pilot study that will determine the effectiveness of innovative thermal remediation to enhance the recovery of nonaqueous phase liquids (NAPLs) from the site. This work will be performed to meet the requirements of the Record of Decision (ROD) for the Soil and Groundwater Operable Units (OUs) (USEPA 2000).

The EPA has selected in-situ thermal technology (steam injection) as the remedy for clean up of soil and groundwater contamination at the Wyckoff/Eagle Harbor Superfund Site. The purpose of the pilot study falls into two broad categories: a) to assess the likelihood that a full-scale thermal remediation will achieve the cleanup goals for the site; b) to provide information for implementation of the potential full-scale thermal remediation. The pilot study design is based on meeting these objectives. In the interim, a sheet pile barrier has been constructed to prevent movement of contaminants beyond the site boundaries. If the pilot study is not successful in demonstrating the effectiveness of thermal treatment and the full scale system is not implemented, a "containment" remedy is now partially in place. The final containment remedy would include the existing sheet pile wall that surrounds contaminated soil and groundwater in the Former Process Area, a replacement groundwater pump-and-treat system to maintain the water level within the sheet pile wall and a soil cap to isolate surface soils in the Former Process Area.

EPA's decision to use this technology was partially based on the success of the steam injection technology at other sites. Steam injection was utilized at the Southern California Edison Pole Yard site in Visalia, California. After two years of operation, steam injection removed/destroyed more than 141,000 gallons of creosote from the subsurface. Of the 141,000 gallons, approximately 55 percent was recovered as a NAPL, and the rest was evenly split between recovery in the water phase, recovery in the vapor phase, and destroyed in-situ via biodegradation and/or hydrous/pyrolysis/oxidation (HPO) process. In comparison, approximately 1,200 gallons of creosote was removed in 20 years by conventional pump-and-treat. The use of steam injection accelerated the removal of creosote contamination by more than 1,000 times.

1.1 OBJECTIVES

The Wyckoff Thermal Remediation Pilot Study is designed to meet the nine primary objectives of the study described in the Record of Decision (ROD) for the Soil and Groundwater Operable Units. These nine objectives can be divided into three broad categories: performance assessment, potential impacts of full-scale thermal treatment on the environment and surrounding community, and process monitoring. The specific project objectives described in the ROD are presented below:

1.1.1 Performance Assessment Objectives

- Demonstrate that thermal remediation technologies will remove substantially all mobile NAPL from the Pilot Study treatment area.
- Demonstrate that the post-thermal treatment concentrations of NAPL constituents dissolved in groundwater that move from the site to Eagle Harbor and Puget Sound will not exceed marine water quality criteria, surface water quality and sediment standards at the mud line.
- Demonstrate that surface soil (0 to 15 ft) concentrations within the Pilot Study area attain MTCA Method B cleanup levels.

1.1.2 Community and Environmental Impacts of Full-Scale Thermal Remediation Objectives

- Determine the potential impacts (noise, air emissions, lower aquifer and odors) of full-scale thermal treatment to the surrounding community.
- Evaluate the possible adverse effects that full scale thermal treatment may have to Eagle Harbor and Puget Sound near shore marine habitats.

1.1.3 Process Objectives

- Evaluate operational approaches to thermal remediation that may impact the removal of NAPL, such as steam movement and recovery of NAPL from the aquitard.
- Evaluate treatment plant performance during the Pilot Study to allow optimization of operations and monitoring mass balance of contaminant removal.
- Evaluate microbial populations before and after thermal treatment to assist in determining long-term contaminant destruction.
- Evaluate contaminant oxidation rates during thermal treatment to assist in mass balance calculations.

1.2 SCOPE

This Management Plan integrates operations planning for the pilot project with operations planning for the existing groundwater treatment plant (GWTP) and extraction system. The GWTP has been in operation since 1990. Contaminated groundwater is obtained from eight extraction wells located within the Wyckoff facility boundary. In addition to recovering and processing groundwater contaminated with pentachlorophenol (PCP) and polycyclic aromatic hydrocarbons (PAHs), the extraction well recovery system is designed to recover NAPL in almost pure product form. The treatment system has also been effective in minimizing offsite migration of contaminants by maintaining hydraulic control of the site. Sampling and analysis requirements for monitoring the performance of the GWTP during pilot operations are included in the Monitoring Plan and Sampling and Analysis Plan (Section 7.0 and Appendix A, respectively).

Thermal remediation relies on steam injection to deliver heat underground in order to mobilize and enhance the recovery of contaminants. Heating the contaminated zone enhances the cleanup of difficult-to-remediate contaminants by:

- Reducing the viscosity of the contaminants to enhance extraction
- Increasing the contaminant vapor pressures to enhance volatilization
- Increasing contaminant solubilities to enhance dissolution
- Increasing microbial degradation and natural oxidation rates

Wells placed within the pilot study area collect the extracted contaminants in a water, vapor, or product phase as NAPL. Existing extraction wells surrounding the pilot study area will continue to collect contaminated groundwater and NAPL and provide hydraulic control outside the pilot study area. The extracted groundwater and condensed vapor are treated in the GWTP and NAPL separated during treatment is disposed of off-site. Non-condensable vapor will be treated on-site in either the boiler or a thermal oxidizer. Not all NAPL in the pilot study area is expected to become mobilized by the delivery of heat. However, soil temperatures are expected to remain high for several months enhancing volatilization and dissolution rates of the residual, relatively immobile NAPL. Ongoing extraction of contaminants will continue for a period of time after steam injection ceases.

Thermal effects will also contribute to enhanced rates of microbial degradation and oxidation (contaminant breakdown) through hydrous/pyrolysis/oxidation (HPO, or oxidation) of contaminant constituents, resulting in non-toxic compounds.

Thermal remediation may be capable of remediating contaminants that occur in both the unsaturated and saturated zones. Therefore, contaminated soil (approximately 30,000 cubic yards) from the Former Log Storage/Peeler Area and the Well CW01 area were excavated and placed within the Former Process Area to be remediated by steam injection if EPA pursues full-scale thermal remediation. In the event that full-scale thermal remediation is not implemented, the surface soils within the Former Process area will be capped as part of the containment remedy. The excavated areas of the Former Log Storage/Peeler Area were backfilled with clean soil. The final grade of the CW01 area was contoured to restore the natural slope of the hillside excavation area.

Active steam injection for the Pilot Study will likely be applied at the Wyckoff site for approximately 6-8 months plus 6 months of monitoring to provide data for the performance assessment.

1.3 REMEDIAL ACTION MANAGEMENT PLAN CONTENTS

This Management Plan includes planning documents for environmental monitoring of the steam injection pilot system, operation and maintenance of the steam injection pilot system and the existing well field surrounding the pilot study area (integrated operations), and operations and maintenance of the existing groundwater treatment plant and extraction system. This Management Plan is intended to serve as the "umbrella" document for the Thermal Remediation Pilot Study and will be updated as the project progresses.

This Management Plan has been organized in the following sections:

Introduction
Site Background
Summary of Site Operations
Project Planning Documents
Project Schedule
Communication Plan
Monitoring Plan
Data Management Plan
Contractor Quality Control Plan
Site-Specific Health and Safety Plan
Spill and Emergency Response Plan
Environmental Protection Plan
Waste Management Plan
References

2.0 SITE BACKGROUND

2.1 SITE LOCATION AND DESCRIPTION

The Wyckoff/Eagle Harbor Superfund site is located on Bainbridge Island, Washington, on the southern shoreline near the entrance to Eagle Harbor (Figure 2-1). The site has been divided into four operable units:

- Wyckoff Soil OU: surface and subsurface soil extending to the maximum elevation of the water table (or other fluid boundary)

- Wyckoff Groundwater OU: subsurface soil and groundwater beneath the maximum elevation of the water table (or other fluid boundary) extending to the sheet pile containment wall.

- West Harbor OU: intertidal and subtidal surface sediments located within the West Harbor OU boundary

- East Harbor OU: intertidal and subtidal surface sediments located within the East Harbor OU boundary

The Wyckoff Soil and Groundwater OUs occupy a relatively flat lowland and intertidal area bounded by a densely vegetated bluff on the south. The lowland area has an average elevation of approximately 10 feet NGVD while the hillside area rises to elevations above 200 feet. A small stream flows north from the hills above the western arm of the property into a culvert that discharges into Eagle Harbor. The north and west portions of the site are bounded by Eagle Harbor, and Puget Sound abuts the eastern margin of the site. The entire Wyckoff property occupies approximately 57 acres (about 18 of which encompass the Soil OU), including a spit with about 0.8 miles of shoreline extending northward into Eagle Harbor. The spit was extended and filled at least twice prior to the 1950s, and was the location of wood treatment activities that have caused the current soil and groundwater contamination.

The focus of Thermal Remediation Pilot Study is the Pilot Study area in the Former Process Area within the Soil and Groundwater OUs. Figure 2-2 is a site plan of the Former Process area. The Pilot Study area comprises approximately 12% of the surface area of the Former Process area.

2.2 SITE HISTORY

Prior to 1904, the Wyckoff property was owned by a sand mining operation and a brickyard. From 1904 through 1988, the site was used for the treatment of wood products (e.g., railroad ties and trestles, telephone poles, pilings, docks and piers) by a succession of owners and companies. Chemicals used at the site include creosote, pentachlorophenol, solvents, gasoline, antifreeze, fuel, waste oil and lubricants. These chemicals were stored in above-ground storage tanks, conveyed through above- and below-ground piping, disposed in sumps, spilled and buried on site.

EPA began an investigation of the property in 1971, and the site was subsequently placed on the National Priority List (in 1987). In 1988, the Wyckoff Company ceased all operations on the property. In 1993, EPA assumed management of the Soil and Groundwater OUs, and in 1994 the assets of the former Wyckoff Company (now Pacific Sound Resources) were placed into an environmental trust.

Over the last 12 months, infrastructure to support the Thermal Remediation Pilot Study has been constructed. Elements of construction include:

- Steam injection and extractions wells.
- Water supply well.
- Subsurface instrumentation.
- Boiler building and tank slabs.
- Underground utilities trenches for electrical power, water lines, and contaminated fluid conveyance piping.
- Vapor cap and vapor collection piping within the Pilot Study Area.
- Improvements in the site's electrical service.
- Installation of the steam generation and injection system.
- Installation of the water and vapor extraction system.
- Modifications to the existing groundwater treatment and processing systems including replacement of the existing depurator with a new Dissolved Air Flotation (DAF) system.
- Above ground mechanical and boiler equipment installation.
- Installation of a fuel storage and supply system.
- Installation of the water supply well pump and associated piping.

2.3 PREVIOUS INVESTIGATIONS AND REMEDIATION EFFORTS

EPA began investigating the Wyckoff property in 1971. The Remedial Investigation (RI) report (CH2M HILL 1997a) contains a summary of the investigations and studies conducted at the site through 1997. During the 1970s, efforts were made to address oil seepage on beaches adjacent to the plant through site inspections and recommendations. During the 1980s, at least five investigations of groundwater, soil, seeps and sediments were conducted at the site to characterize the extent of contamination. Investigations continued in the 1990s and have included a focused Remedial Investigation/Feasibility Study (RI/FS) (CH2M HILL 1994) for the Groundwater OU to provide administrative justification for interim removal actions and a full RI/FS (CH2M HILL 1997a, 1997b).

Source control and remediation activities have been conducted at the site since 1981 to mitigate actual or potential threats to human health or the environment. Table 1-3 of the RI report provides a list of these activities. They have included removal and offsite disposal of structures including buildings, sumps and retorts; storage tanks; pipelines; asbestos and selected docks and pilings. A groundwater extraction and treatment system has been operational since 1990 to minimize further releases and recover as much NAPL as possible. New wells have been installed for monitoring and extraction purposes and approximately 19 deteriorated wells have been abandoned.

Geotechnical investigations for design of a slurry wall began in February 1997, for the purpose of establishing the depth and continuity of the aquitard along the proposed alignment, and to collect soil data required for design of the wall. Initially, soil borings were drilled on 50 to 100-foot centers along the alignment proposed in the FS report (CH2M HILL 1997b). Alignment changes were made to accommodate anticipated excavation equipment limitations, and the area of investigation was gradually extended during the drilling program as additional NAPL was discovered in the subsurface. Eventually a total of 43 auger borings were drilled, sampled and abandoned. Large amounts of NAPL were detected along the shoreline areas, indicating that part of the slurry wall should extend offshore; consequently an additional 11 soil borings were drilled in January 1998. Blow counts were recorded in all borings for a 3-inch split-spoon driven with a 300-pound hammer, and samples from all of the borings were tested for gradation and Atterberg limits. Samples from the vadose zone were also tested for moisture content, and offshore samples were tested for NAPL saturation and density, and pore water salinity and density.

New and promising developments in the use of thermal remediation technologies at NAPL contaminated sites prompted EPA to delay the slurry wall design effort and begin evaluating thermal techniques. CH2M Hill produced a comparative analysis of thermal technologies and containment remedies for the site that concluded that thermal technologies could provide an effective remedial option for the Wyckoff site. EPA tasked USACE to conduct a NAPL Field Exploration in the summer of 1999 to obtain site-specific data to complete the evaluation. The NAPL Field Exploration used Site Characterization and Analysis Penetrometer System (SCAPS) equipped with a Laser Induced Fluorescence (LIF) probe to identify NAPL zones on the upland portion of the site and estimate the extent of NAPL contamination. Physical and chemical data was also collected using traditional drilling methods and existing monitoring wells to address specific thermal remediation design issues. In addition, a Geoprobe direct push rig was mobilized to the intertidal area adjacent to the Wyckoff facility to determine the depth of the underlying confining layer to support the design of a sheet pile containment wall. The Corps has also investigated the horizontal and vertical extent of contamination of the western side of the Wyckoff site to obtain design level data for a soil removal plan.

These latest investigative activities directly supported the installation of a sheet pile containment wall along the shoreline of the site to minimize the discharge of free product and contaminated groundwater into the marine environment. In addition to the outer containment wall, a smaller sheet pile wall was install in the middle of the Former Process Area to provide a test cell for the thermal remediation pilot study. The purpose of the smaller sheet pile wall is to isolate the Pilot

Area to reduce the potential for recontamination and to mimic the potential impact of a containment wall on full scale implementation of thermal remediation technologies.

2.4 GEOLOGY

The Wyckoff site straddles the boundary between (1) a glacial drift plain deposited 13,000 to 15,000 years ago as part of the Vashon Stade of the Fraser Glaciation and (2) marine and fluvial deposits of the Seattle Basin. Contaminated groundwater extends to a maximum depth of 110 feet below ground surface, spanning eight stratigraphic units identified in the RI report (CH2M HILL 1997) and the Corps of Engineers (USACE 2000a). The consecutive stratigraphy through the pilot area and into the lower aquifer is as follows:

- Fill
- Non-marine clay
- Cap material
- Surficial marine sediment
- Marine sand and gravel
- Marine silt
- Glacial clay, silt and sand
- Fluvial sand

Contaminated soil is restricted to the upper aquifer, which consists of the fill unit and the marine sand and gravel unit. This aquifer overlies an aquitard consisting of the marine silt unit and the glacial clay, silt and sand unit. Contamination has also been discovered in sandy zones and thin lenses within the glacial portion of the aquitard.

2.4.1 Fill

Fill material, imported from nearby, unspecified sources, had been placed on the property to extend the shoreline into Eagle Harbor and Puget Sound. The fill is reported to be approximately 10 feet thick across the property and may be as thick as 20 feet along the northern and eastern edges of the spit. It reportedly consists of dredged silt and fine-grained sand similar in physical characteristics to the underlying marine sand and gravel unit making it difficult to differentiate between the two units.

2.4.2 Marine Sand and Gravel

The marine sand and gravel unit is a nearshore marine/beach deposit present over nearly all of the site. It reaches a maximum thickness of approximately 70 feet on the north and northeast portions of the site and thins southward, eventually pinching out against the underlying glacial deposits. The marine sand and gravel underlies the fill and is generally continuous to the top of the marine silt or the glacial deposits.

2.4.3 Marine Silt

The marine silt layer is a nearshore lagoon or marsh deposit that occurs below the marine sand and gravel in the northern and eastern portions of the site. It is characterized by an olive-gray color, abundant shell and wood fragments, and occasional layers of silty sand, sand, and clay. Thickness ranges from less than 1 foot to 16 feet, and the unit pinches out toward the southern edge of the spit. The presence of wood fragments and hydrogen sulfide odor in samples indicate a reducing depositional environment.

2.4.4 Glacial Clay, Silt, and Sand

The glacial clay, silt, and sand unit lies stratigraphically beneath the marine silt and the marine sand and gravel deposits. The glacial deposits are continuous under the site, varying in thickness from five to thirty-five feet. The RI report (CH2M HILL 1997) divides the glacial deposits into three sub-units: gray-brown silty sand, blue-gray silt/clay, and gray-brown silt/clay.

2.4.5 Fluvial Sand

The fluvial sand unit lies below the glacial unit, and consists of dense to very dense, gray-brown to brown, well-graded to poorly-graded sand with variable amounts of gravel and cobbles, and no organic material. Interbeds of silty sand and silt up to about 1 foot thick are present.

2.4.6 Non-marine Clay

The non-marine clay is an onshore colluvium, landslide, or fill deposit, generally lying stratigraphically above the marine sand and gravel. The non-marine clay generally consists of gray to brown, very soft to medium clay to brown clayey fine sand. Occasional plant fibers, wood and roots are present, as well as iron oxide staining. In general, the non-marine clay acts as an impediment to NAPL migration.

The thickest section of non-marine clay appears near the south corner of the transfer pit. A clayey silt zone was encountered from near the ground surface to a depth of about 24 feet, near the top of the glacial portion of the aquitard. Neither the marine sand aquifer, nor the marine silt portion of the aquitard appeared to be present at this location. In the lower portion of the clayey silt zone, a decayed, foul-smelling silt and peat zone has been encountered just above the glacial deposits. High saturation levels of mobile NAPL occurred in the clayey silt and silty peat zones.

2.4.7 Surficial Marine Sediment

Surficial marine sediments generally occur on the harbor bottom directly over the marine sand and gravel unit, and appear to be the result of post-dredging sedimentation. These sediments consist of soft, black to olive-black silt with wood, plant, and shell fragments, reaching a maximum thickness greater than ten feet in the center of the trough southwest of the former West Dock. Although the unit appears to have low permeability, it contains abundant dense non-aqueous phase liquid (DNAPL) southwest of the former West Dock.

2.4.8 Cap Material

Cap material, consisting of dark gray silty, fine to coarse sand with wood chips and plant fibers, was dredged from the Snohomish River and placed in Eagle Harbor. The average cap thickness is about 2.5 feet. The cap material is moderately permeable and occasionally contains DNAPL near the contact with the underlying surficial marine sediments.

2.5 HYDROGEOLOGY

The following hydrogeological information is summarized from the RI report (CH2M HILL 1997).

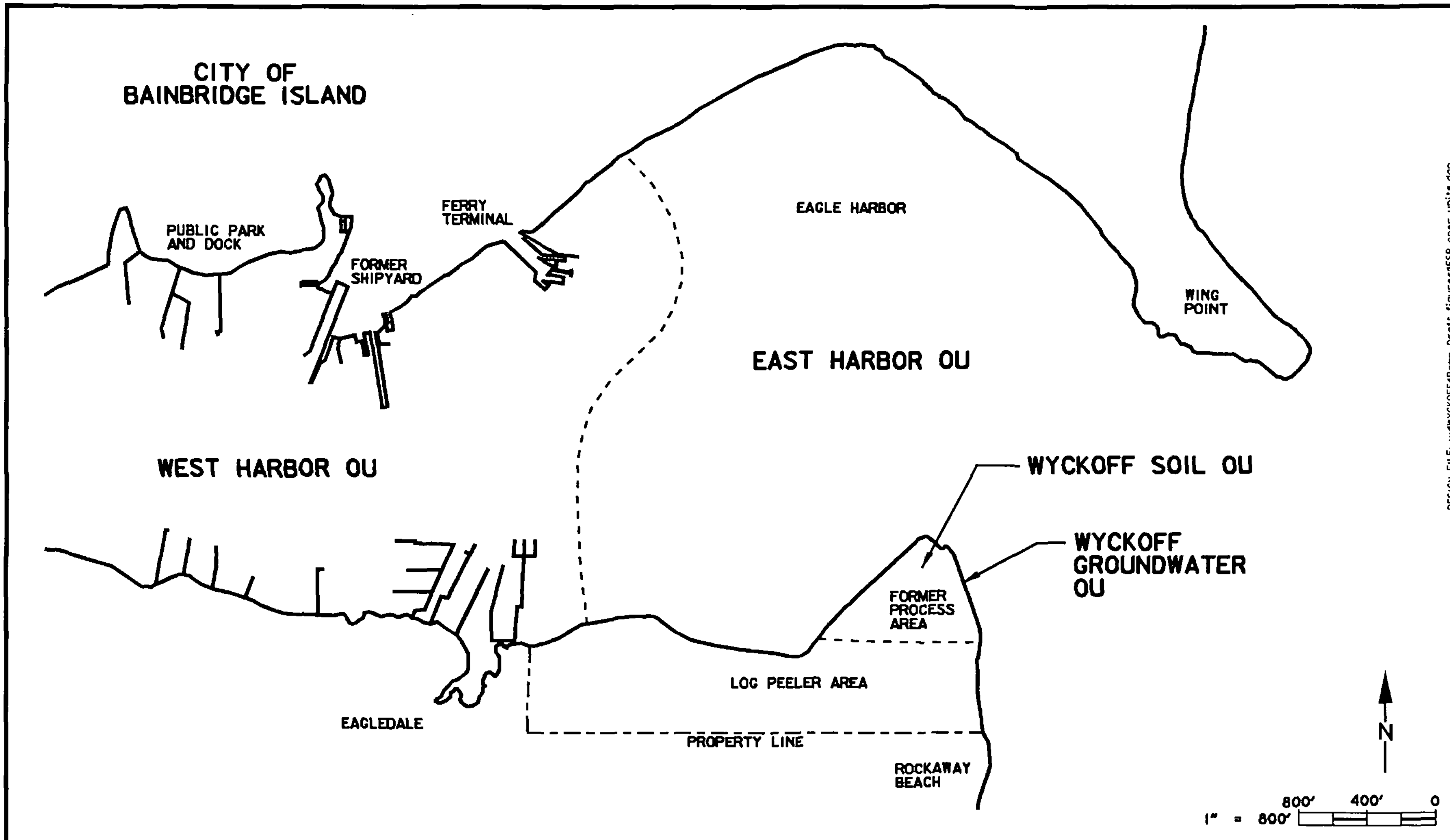
Groundwater recharge on Bainbridge Island comes solely from precipitation. Groundwater is present at the site within aquifers separated by low hydraulic conductivity layers. The uppermost aquifer at the Wyckoff site consists of the fill unit and the marine sand and gravel unit. The upper aquifer is unconfined with groundwater levels approximately 5 to 10 feet below ground surface. Horizontal hydraulic conductivity values are estimated to range from approximately 10 to 30 feet/day. Tidal influences within the upper aquifer range in magnitude from 1 to10 feet with the highest tidally induced changes near the shoreline.

The upper aquifer is separated from the lower aquifer (fluvial deposits) by an aquitard composed of both marine silt and glacial deposits. The lower aquifer appears to be continuous across the site. Groundwater elevations in the lower aquifer are similar to the upper aquifer (approximately 5 to 10 feet below ground surface). Measured hydraulic conductivity values range from 1 to 25 feet/day. The lower aquifer is affected by tidal influences to a similar degree as the upper aquifer.

Generally, groundwater flow within the upper and lower aquifers is north toward Eagle Harbor and Puget Sound from the southern portion of the property, upward from the lower aquifer to the upper aquifer, and upward within the lower aquifer. Vertical gradients within the upper aquifer and between the upper and lower aquifers have been observed to reverse at low tide in the northeastern portion of the site. Pumping tests have shown evidence of possible hydraulic connections between the upper and lower aquifers in the southern and eastern portions of the site.

Deeper aquifers are known to be present beneath the site. Groundwater is thought to flow regionally toward Puget Sound within these aquifers and locally toward pumping wells. However, little information is available regarding the extent and hydraulic characteristics of these aquifers.

Additional upper aquifer testing conducted after installation of the Pilot Area extraction wells indicated that horizontal conductivity within the Pilot Study Area is in the range of 15 to 30 feet/day. The average vertical anisotropy in the Pilot Area is in the range of 3 to 10.

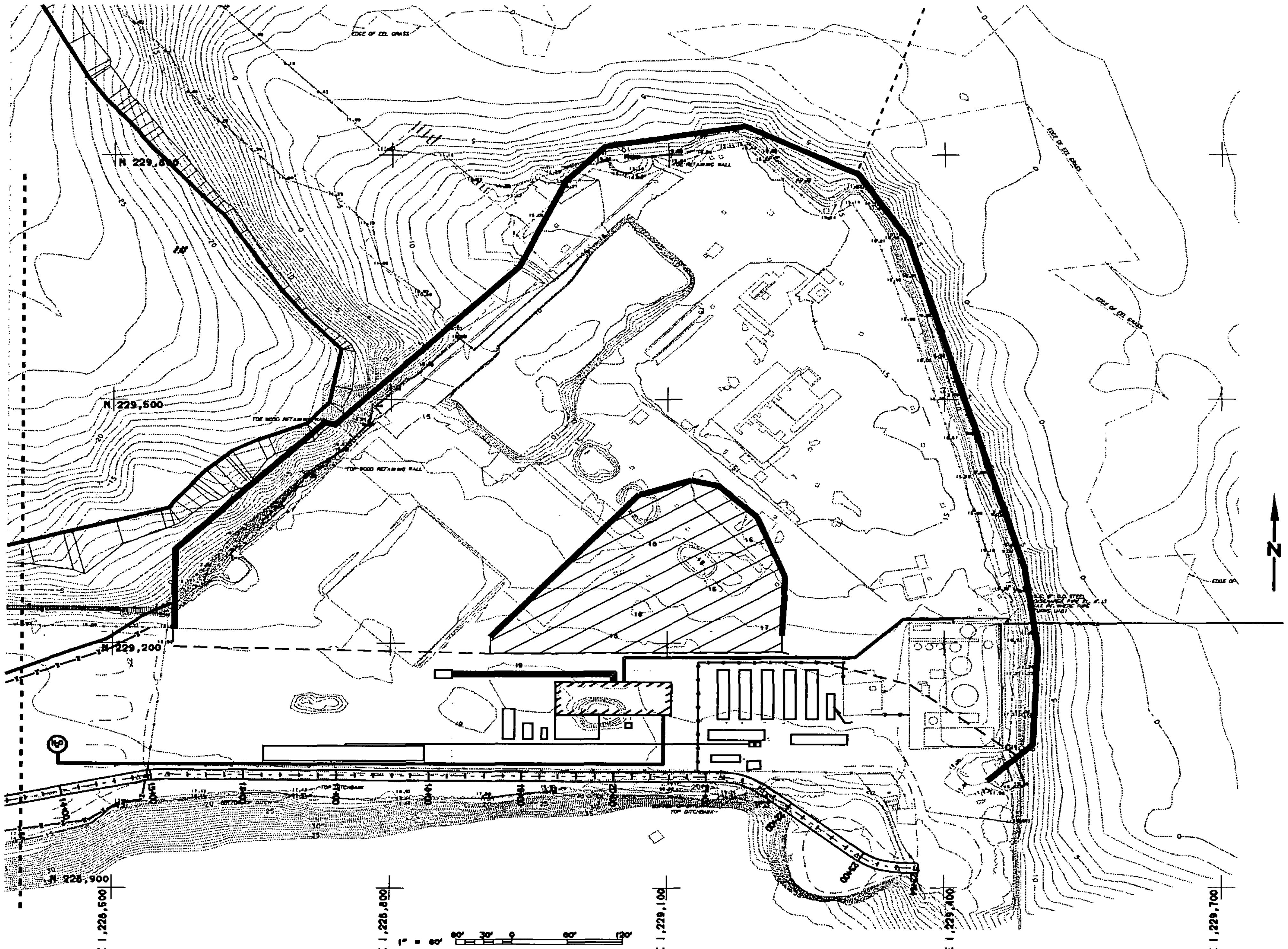


US Army Corps
of Engineers
Seattle District

FIGURE 2-1
LOCATIONS OF OPERABLE UNITS AT
WYCKOFF/EAGLE HARBOR SUPERFUND SITE

THERMAL REMEDIATION
PILOT PROJECT

WYCKOFF/EAGLE HARBOR SUPERFUND SITE
BAINBRIDGE ISLAND, WASHINGTON



This project was designed by the Seattle District U.S. Army Corps of Engineers. The initials or signatures and registration designations of individuals appear within the specifications or on these project documents within the scope of their employment as required by ER 1110-1-8152, Professional Registration.

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REVISIONS				
SYMBOL	ZONE	DESCRIPTION	DATE	BY

U.S. ARMY ENGINEER DISTRICT, SEATTLE
CORPS OF ENGINEERS
SEATTLE, WASHINGTON

WYCKOFF/EAGLE HARBOR SUPERFUND SITE
SITE PLAN

FIGURE 2-2

BAINBRIDGE ISLAND PN C1898 WASHINGTON

SIZE	INVITATION NO.	FILE NO.	DATE:	PLATE
D		E-54-1-16	13APR01	C-2
DSGN. MAHER		CHK.	SHEET 5	

3.0 SUMMARY OF SITE OPERATIONS

This Management Plan integrates operations planning for the pilot study with operations planning for the existing groundwater treatment plant (GWTP) and extraction system. This section presents an overview of the different operations planned for the site before, during, and after the pilot study. Operations include activities associated with performance and compliance monitoring of the system and operation of the steam system and GWTP.

The pilot study will be operated to comply with the 1988 Consent Decree- Effluent Discharge Limitations and Biomonitoring Requirements and all modifications to that order (CH2MHill 2000). In general, the Consent Decree and subsequent modifications provide a detailed set of effluent discharge limitations and analytical monitoring requirements including daily maximums and monthly averages. The decree also provides detailed information on biomonitoring required for acute and chronic toxicity testing of the effluent discharge to Puget Sound.

3.1 SYSTEM PERFORMANCE AND COMPLIANCE MONITORING

The objectives of the pilot study are presented in Section 1.0. Monitoring of the system and collection of data throughout the study are crucial for meeting these objectives. Details of the monitoring program, including regulatory requirements, sampling and analysis methods, and quality assurance/quality control requirements, are included in the Monitoring Plan and Sampling and Analysis Plan (Section 7.0 and Appendix A, respectively).

3.2 SYSTEM OPERATIONS

A general description of anticipated procedures that may be used during thermal treatment pilot system operations at the Wyckoff/Eagle Harbor Superfund Site is included in this section. These procedures were developed out of discussions with consultants, experience with other sites, and engineering analyses including fluid and heat flow calculations, and numerical modeling. Due to the innovative nature of the thermal treatment technology and the heterogeneous subsurface conditions of materials at the project site, procedures will be continuously re-evaluated during the pilot study. The treatment strategy may be revised based on conditions encountered during system construction, commissioning and on monitoring results during operations.

3.2.1 Considerations

The following paragraphs describe theoretical concepts, site characteristics, and system and equipment limitations that are expected to influence site operations:

Theoretical Considerations

- Modeling studies show that the relative extent of the steam zone in horizontal and vertical directions is strongly influenced by the ratio of horizontal to vertical permeability.

- The relatively constant effect of steam buoyancy has a significant influence on vertical steam migration. Horizontal steam migration is strongly effected by the steam injection pressure and fluid extraction rates, which can be varied during operations.
- The density of NAPL at the project site is similar to the density of groundwater, and much of the NAPL is suspended in layers within the aquifer. Changing water levels could cause suspended NAPL to spread vertically, interfering with its ability to flow horizontally toward extraction wells.
- According to some theories, the residual saturation of oil in the presence of gas is less than in the presence of water; therefore it may be possible to extract more oil by pumping if gas saturations are optimized in the subsurface.
- Hot groundwater is expected to boil during the shut-in phase (collapse of the steam zone resulting in a low pressure zone in the subsurface) of pressure-cycling operations; this phenomenon is thought to enhance partitioning of NAPL into the vapor and aqueous phases.

Site Considerations

- Aquifer test analyses in the upper aquifer show horizontal hydraulic conductivities varying from less than 1 ft/d to around 60 ft/d, and horizontal to vertical hydraulic conductivity ratios (vertical anisotropy) in the range of 2 to 100. Some of the tests would have been affected by shoreline recharge, which would cause horizontal hydraulic conductivity and vertical anisotropy to be overestimated.
- Calibrations of the site groundwater model produced an average horizontal hydraulic conductivity value of 10 ft/d and an average vertical anisotropy value of 20. Additional aquifer testing conducted after installation of the Pilot Area extraction wells indicated the horizontal conductivity within the Pilot Area is in the range of 15 to 30 ft/d. The average vertical anisotropy in the Pilot Area is in the range of 3 to 10.
- During thermal treatment operations, recharge of groundwater and oxygen to the test site is expected to be somewhat limited by the sheet pile wall and the vapor cap.
- Most of the NAPL is concentrated in the northern third of the Pilot Test Area. About 2/3 of the NAPL appears to be light non-aqueous phase liquid (LNAPL), suspended within about 5 feet of the static water level. The remaining NAPL is DNAPL, lying just above or directly on the aquitard.
- In the area south of the Pilot Area well field, NAPL has been observed as occurring in thin (1/8-1/4") saturated layers, lenses and ganglia as well as staining in soil and coatings on soil grains. Intervals where mobile NAPL was identified are more common in the western half of the area and relatively uncommon in the eastern half. Consequently, some recontamination of the treated portion of the Pilot Area could result from NAPL located upgradient of the treated area. However, it is believed that verification of treatment effectiveness will not be affected, because NAPL migration rates should be slow enough that any recontamination will only occur at the southern margin of the well field.

- The aquitard underlying the upper aquifer has a northwestward slope, averaging 7 degrees from horizontal.
- The aquitard underlying the Pilot Study Area appears continuous with the exception of two anomalous features:
- A structural anomaly was discovered during the pre-construction investigation in the vicinity of extraction well E-1. The anomaly appears to be a "trench" in the surface of the glacial till running in a northwesterly direction.
- Water level data collected after installation of the extraction wells indicates that extraction well E-6 is influenced by changes in tidal elevation. The apparent tidal influence indicates connection between the upper and lower aquifers in the area and indicates that the glacial till is more permeable in the vicinity of E-6.
- The piezometric level in the lower aquifer is currently 1 to 2 feet higher than the static water level in the upper aquifer; thus water level buildups greater that about 1 foot in the Pilot Area could result in downward flow, and potential contaminant migration through the aquitard.
- Low permeable silt fill material is evident in the southwest corner of the Pilot Study area (west of I-9 and south of I-4). This material contained extensive NAPL contamination. The low permeability of this material may restrict steam injection.
- Temperature monitoring along the sheet pile wall will need to be closely evaluated during operations to avoid the formation of "dead zones" where NAPL may accumulate against the wall between injection and extraction wells.

Operational Considerations

- Available subsurface data indicates that the total steam injection capacity of all wells in the Pilot Area is less than the steam plant capacity; i.e. steam can be injected in all wells simultaneously at maximum pressures.
- The capacity of the groundwater treatment plant imposes operational limits on the amount of liquid that can be extracted from the site as a whole. Consequently, steam injection in the Pilot Study area must be balanced with the flow of contaminated groundwater from outside the Pilot Area required to maintain hydraulic control of the entire site.
- Soils in the treatment area are expected to be heterogeneous, and their characteristics are subject to some uncertainty. While the objective is to manage the Pilot Study as single unit, differences in stratigraphy around individual arrays (the treatment zone around individual extraction wells) may dictate differences in both steam injection and extraction rates. The thermal systems are therefore designed to offer flexibility, so that different subsurface conditions and operational scenarios can be addressed.

It is expected that the operations team will review monitoring data at least on a daily basis, and changes will be made in injection pressures, extraction vacuums, and pumping rates at various locations on the site, as dictated by the evaluations of the data.

3.2.2 Operations Plan

The thermal treatment process is expected to be performed as described below. Operations begin with initial heating of the subsurface until steady state is reached and a reduction in contaminant recovery is observed. Once a steady-state condition is reached (liquid NAPL recovery has peaked and begins to diminish), pressure cycling will begin. Pressure cycling is used to optimize liquid-phase recovery at low NAPL saturations. When the operations team has determined that steam injection has achieved the maximum practical removal of contaminants, steam operations will be halted. Pumping and vapor extraction will continue while subsurface data are monitored to determine the extent of continuing contaminant reduction. Following the pilot study, liquid extraction and treatment with the GWTP will continue when the system has cooled down.

Initial Heating

Significant steam flow will begin with one of the deeper wells in the northeast portion of the Pilot Area. As the injection rate stabilizes, additional wells will be brought on line, one at a time, most likely continuing with wells in the northeast portion and proceeding to the west and south ends of the Pilot Area. Water levels in the aquifer will be carefully managed to minimize vertical spreading of NAPL.

Steam injection will begin in injection wells I-2, I-6, I-7 and I-8 surrounding extraction well E-6. The array around E-6 was selected to initiate significant steam injection due to the greater depth of NAPL in this area. Concurrently, the liquid extraction rate out of E-6 will be increased in an effort to enhance the upward gradient of groundwater flow to minimize the potential of mobilized NAPL migrating into the lower aquifer. Migration of NAPL into the lower aquifer is of particular concern in this array based on evidence of communication between the upper and lower aquifer. The initial extraction rate will be targeted to create no more than 5 feet of draw down at thermal extraction well E-6.

Since steam will move out from injection wells in all directions, the next array to be brought online will be the injection wells around extraction well E-2 (I-1 and I-5). This array was selected based on the relative depth to the aquitard in this area. Injection wells I-10, I-14 and I-15 will then be brought online with extraction well E-5. Once injection pressures and extraction rates stabilize in these areas, the next set of injection wells will be brought on line. These injections wells (I-3, I-4 and I-9) serve extraction wells E-1 and E-4. The smaller and shallower arrays around E-3 and E-7 will be brought online last when injection begins in injection wells I-11, I-12, I-13 and I-16. The pacing of this sequence will be governed by closely monitoring steam injection pressures and the need to balance extraction rates and water levels across the entire site, but is not anticipated to take more than a single shift to complete.

Initial target liquid extraction rates will be between 30 and 50 gpm for the entire Pilot Area (an average of 4 to 7 gpm per well) with a vacuum of 2 to10 inches of Mercury. No more than 10 feet of draw down will be allowed in any single extraction well. Steam injection rates will be initiated at 400 to 800 lbs/hr per well. This will lead to an overall injection rate of between 6,500 to 13,000 lbs/hr of steam (equivalent to 13 to 26 gpm of water). Once steam injection is stabilized, air injection will be initiated at between 1 to 5 scfm per injection well unless air injection interferes with maintaining the desired steam injection rate.

It is anticipated that steam will break through to the extraction wells and the surface vapor collector about 2 to 4 weeks after steam injection is commenced in individual arrays. Progress of the steam zones will be monitored, and control strategies will be exercised (Section 3.2.5) to maintain the desired heat and fluid migration pattern. Aquitard heating is expected be a critical factor in selection of control strategies.

Pressure Cycling

It is anticipated that pressure cycling will begin when steam has penetrated all extraction wells and the vapor collector within the treatment zone, and most of the treatment zone is fully heated to maximum temperatures. The exact start time for pressure cycling will be determined by the site operations team, based on evaluations of steam zone development. The goal will be to begin pressure cycling after liquid NAPL recovery has peaked and begins to diminish. When pressure cycling is initiated, steam flow to the injection wells will be reduced. Alterations may also be made in pumping rates and vapor extraction pressures during steam pressure cycles.

Temperatures, pressures and contaminant mass-removal rates will be monitored, and steam injection will be resumed after a suitable time period, to be determined by the operations team. Steam injection will continue until the next pressure cycle is started, at a time to be determined by the operations team. It is anticipated that pressure-cycle durations will be a few days to a few weeks; the optimum length will be verified by experimentation in the field.

The primary objective of pressure cycling is to optimize liquid-phase recovery at low NAPL saturations, by maintaining an economical mixture of groundwater and steam in the aquifer. The water levels and water balance in the treatment area will be carefully monitored, and maximum practical water saturations will be maintained by management of fluid extraction rates and steam injection. Theoretically, enhanced contaminant recovery will take place along the capillary fringe. Consequently, careful management of liquid levels in the Pilot Area will be the primary method of optimizing contaminant recovery. The operations team will determine when the full potential of pressure cycling with maximum water saturation activities has been realized. Contaminant removal rates are expected to be one of the primary evaluation tools for system performance.

The objective of pressure cycling with maximum gas saturation would be to maximize vapor-phase transport, after substantial liquid-phase contaminant has been removed under maximum water saturation conditions. In addition, it is anticipated that aquitard heating can be optimized during pressure cycling with maximum gas saturation. Pressure-cycling procedures will be continued as described above, however the groundwater saturations in the aquifer will be reduced (i.e. gas saturation increased) by increasing pumping rates, vapor extraction rates, or by any other means selected by the operations team. The degree to which pressure cycling under maximum gas saturation strategy can be implemented will be limited by the treatment plant heat exchanger capacity, since higher subsurface gas saturations will most likely result in increased steam extraction and a greater cooling requirement. Pressure cycling with maximum gas saturation will only be initiated after fully utilizing contaminant recovery under water saturation conditions.

Fluid Extraction and Monitoring

When the operations team has determined that steam injection has achieved the maximum practical removal of contaminants, steam operations will be halted. Pumping and vapor extraction will continue while subsurface data are monitored to determine the extent of continuing contaminant reduction.

At the completion of steam operations, continued vapor and liquid extraction and treatment will occur. Vapor extraction will slow during this phase and should cease. Subsurface monitoring will continue to determine the extent of continuing contaminant reduction.

Operation and Maintenance Periods for Water Treatment Plant (Non-Steam Phase) and Extraction System

This phase includes site wide liquid extraction and treatment. No vapor extraction or treatment is anticipated during this phase.

3.2.3 Operational Controls

The operations team will evaluate monitoring data and utilize all applicable methods to manage the thermal remediation. The following paragraphs list several methods that could possibly be used to control heat and fluid flow in specific areas of the project site. Some of the control methods may not always have the desired effect, and experimentation may be required. Additional control methods not listed may reveal themselves during the pilot study.

Water Level Controls

If the water level is too low:

- Decrease pumping rate.
- Increase vacuum at the extraction well.
- Decrease steam quality.

If the water level is too high:

- Increase pumping rate.
- Decrease vacuum at the extraction well.
- Increase steam quality.

Horizontal Steam Migration Controls

If steam migration or heating is too slow:

- Increase injection pressure to maximum safe value.
- Increase pumping rates to draw hot water into cold areas.
- Increase vapor extraction rate to draw steam into cold areas.
- Install additional steam injection wells in cold areas.

If steam migration is too rapid in some areas, i.e. non-uniform flow within an array:

- Reduce injection well pressure, or stop steam injection.
- Reduce extraction well pumping rate, and/or vacuum.

Vertical Steam Migration Controls

If vertical steam migration is too slow, relative to horizontal migration:

- Reduce the steam injection rate, causing horizontal steam migration to slow down.
- Increase vacuum in the surface collector, to increase the vertical steam migration velocity.

If vertical steam migration is too fast (i. e. breakthrough to the collector layer will occur before breakthrough to the extraction well):

- Decrease vacuum in the surface vapor collector.
- Increase injection pressure, if possible.
- Increase pumping rate.
- Increase vacuum on the extraction well.

Aquitard Sweeping Controls

If the steam zone is not contacting the aquitard:

- Decrease vacuum in the surface vapor collector.
- Increase injection pressure, if possible.
- Increase the pumping rate.
- Consider increasing the vacuum on the extraction well.
- Consider redeveloping injection wells.
- Reduce steam quality (sweep the aquitard with hot water).
- Add injection wells where aquitard sweeping is poor.

3.3 GROUNDWATER TREATMENT PLANT AND EXTRACTION SYSTEM OPERATIONS

Operation of the existing extraction and GWTP is being altered to meet the new demands placed on the system by adding the thermal treatment component. Two issues for the operations team and the surrounding community are water usage in an area of a limited water resource and capacity of GWTP during the pilot study.

3.3.1 Water Usage

Actual water usage during the thermal remediation pilot study is an important issue not only to the design and operations team at USACE and EPA, but also to the city, surrounding property owners and the local community. Bainbridge Island has water resource limitations, which impacts planning and development on the island. In addition, adjacent property owners are concerned about the potential impact of water withdraws from the pilot study may have on their own water supply wells. Consequently, the design team has attempted to balance project requirements for boiler feed water and non-contact cooling water with budget constraints and community concerns about excessive water withdraws. The issue is further complicated by the recognition that many of the factors that will affect water usage during the pilot study relate to operational scenarios that can only be estimated at this time.

From an engineering standpoint, the current system is designed to provide the maximum feed water supply to the boiler and maximum non-contact cooling water to the heat exchangers without regard to operational constraints. This is standard engineering practice to ensure correct sizing of conveyance system piping, pumps and other parts of the mechanical systems. Under this narrow engineering design focus, water usage during the pilot study can be described in the following manner:

Maximum Water Usage

Supply water from an on-site well will be used to generate steam as well as to provide cooling for the hot extracted liquids and vapors from the pilot study well field. The extracted liquids require cooling prior to entering the liquid treatment plant to ensure optimal conditions for the aeration basin microbes. Cooling will be accomplished through the use of a heat exchanger where cooling water will be used to transfer heat from the extracted liquid. The extracted liquid from the well field enters the heat exchanger at approximately 90° C and will be cooled to approximately 40° C. The non-contact cooling water from the water supply well that enters the heat exchanger at approximately at 15° C will be heated to approximately 80° C. The now warm non-contact cooling is then sent to the boiler to generate steam. The maximum amount of water required to cool the extracted water is 50 gpm based on a maximum extraction rate from the pilot area of 50 gpm.

The extracted vapor contains water vapor entrained with contaminants and vapors that do not condense ("non-condensable" vapors). To remove the water vapor and the entrained contaminants, condensing of the extracted vapor is required. A condenser uses cold water to transfer heat from the vapor to promote condensation. The maximum amount of water required to condense the extracted vapor is 50 gpm to cool a maximum of 450 acfm of vapor at 90°C. The now hot non-contact cooling water will be used by the boiler to generate steam.

The maximum scenario of cooling and condensing requires 100 gpm of non-contact cooling water. At maximum firing, the boiler requires a maximum of 57 gpm of heated feed water to generate steam. Therefore, approximately 43 gpm of excess water would be discharged to the outfall. However, this maximum scenario will never occur due to overriding operational constraints.

3.3.2 Capacity of the GWTP

The primary operational constraint for water usage during the pilot study is the capacity of the treatment plant. While this part of the facility was upgraded prior to steam injection, the nominal operational capacity is not likely to exceed 85 gpm. Out of this 85 gpm, a maximum of 35 gpm must be reserved for treating contaminated groundwater from the area outside the pilot study area. Groundwater extraction must continue from this area to maintain hydraulic control of the entire site. Consequently, extraction out of the pilot area will be limited to 50 gpm. This 50 gpm target level must be partitioned between hot extracted liquids, liquid condensed from the vapor waste stream and at least 10 gpm to maintain hydraulic control of the pilot area.

Water usage fluctuations can be estimated for the three major phases of thermal operations; site heating phase, pressure cycling shut-in phase, and the re-initiation of steam injection. These estimates contain a good deal of uncertainty since several factors will influence water usage and system performance. Many of these factors and how they impact operations will not be known until steam injection actually begins.

3.3.3 Water Usage During Site Heating

This phase of thermal operations is accomplished during the first 3 to 4 weeks of steam injection. The goal of this phase is to complete the initial warming of the pilot area. Steam will be injected into all 16 injection wells at an average rate about 0.2 kg/s (3.2 gpm I.e) for a total feed water demand not to exceed 40 gpm due to treatment plant capacity limitations. Simultaneously, liquid extraction from the pilot area will need to be set to maintain hydraulic control and to withdraw condensed steam. Modeling predicts that an extraction rate of 8 gpm may be required per extraction well to remove the added liquid while maintaining hydraulic control of the pilot area. However, this rate of extraction will not be possible to achieve given the limits on liquid treatment plant capacity. Consequently, extraction rates will need to be balanced with injection rates. Since the initial steam injection is occurring at the end of summer, when water levels are already at the lowest point of the year, minimal extraction should be required to maintain hydraulic control of the pilot area. This will allow almost all of the pilot area extraction flow to be comprised of condensed steam.

Non-contact cooling requirements during the initial heating phase will range from zero to approximately 40 gpm. At the beginning of steam injection, extracted fluids will not be as hot thus requiring very little non-contact cooling water. As the site warms, the cooling water required to reduce the extracted fluid temperature will lag behind the boiler feed water requirements. As a result, all the non-contact cooling water will be directed for use as feed water for the boiler. Vapor extraction rates are also estimated by thermal modeling to be minimal during the initial heating phase. Without a substantial volume of vapor recovery, non-contact cooling water requirements remain stable and balanced with steam injection flow rates (Table 3-1).

Table 3-1
Water Usage During Site Heating Phase

Water Use	Ave. Flow Rate per Well (gpm)	No. of Wells	Total Water Usage
Boiler Feed Water	2.5	16	40
Non-contact Cooling Water:			
- Extracted Liquid Cooling	5.7	7	0 to 40
- Extracted Vapor Cooling	0	7	0
Total Water Usage			Max. 40

Once the entire pilot area is heated, the operation team will need to continue monitoring steam injection rates, extraction rates and contaminant recovery rates. Conceptually, it may be advantageous to prolong the heating phase while maintaining a generally fixed liquid level within the pilot area to enhance NAPL recovery rates. At some point, liquid contaminant recovery will likely begin to diminish which will set the stage for pressure cycling.

3.3.4 Water Usage During Pressure Cycling Shut-In Phase

Once liquid contaminant recovery begins to diminish and steam begins to break through to the extraction wells, pressure cycling will begin. The initial step in this phase of operations will be to reduce steam injection to a minimal amount needed to keep some pressure across the injection well screens (approximately 16 gpm per well) (Table 3-2). This is done to prevent the injection wells from silting up and fouling. As the steam front condenses and collapses, a vacuum will form in the subsurface within the pilot area. As a result, very little vapor will be recovered since the subsurface vacuum will be greater than the capacity of the liquid ring vacuum pumps installed on site. At the same time, liquid extraction rates will need to be cut back to avoid totally de-watering the pilot area. Model results predict a total liquid extraction rate as low as 5 to 6 gpm is needed before groundwater recharge begins to occur. Eventually, the subsurface vacuum will diminish and vapor recovery rates will increase for a short period of time. To condense this spike in recovered vapor, approximately 1 gpm of non-contact cooling water will be needed during the initial pressure cycle. The shut –in phase is expected to last approximately one week.

Table 3-2
Water Usage During Pressure Cycling Shut-In Phase

Water Use	**Ave. Flow Rate per Well (gpm)**	**No. of Wells**	**Total Water Usage (gpm)**
Boiler Feed Water	1	16	16
Non-contact Cooling Water:			
- Extracted Liquid Cooling	2	7	14

- Extracted Vapor Cooling	0 to 1.28	7	0 to 9
Total Water Usage			Max. 23

Non-contacting cooling water requirements may be greater than boiler feed water requirements during the later days of this operational phase. System operations will need to be monitored closely to avoid excess non-contact cooling water from being generated and subsequently directed to the outfall.

3.3.5 Water Usage During Re-Initiation of Steam Injection

The end of the shut-in phase will be signaled by an increase in water levels as cool groundwater begins to enter the pilot area and a corresponding decrease in the concentration of contaminants recovered in the vapor phase is noted. Steam injection will be re-initiated at the maximum rate within the limits of the treatment plant's capacity (40 gpm). At the same time, more aggressive liquid extraction will occur to keep pace with the increased injection rates. Thermal modeling predicts that a lag will occur between the initial steam re-injection and increased recovery of extracted hot liquids and vapors. Initially, boiler feed water requirements will exceed non-contact cooling water needs. Since the subsurface will already be hot, steam front movement should be fairly rapid resulting in steam breakthrough at the extraction wells within 5 days. Liquid and vapor extraction will need to be closely monitored to avoid excessive non-contact cooling requirements just when steam injection needs to be reduced due to break through at an extraction well. This scenario could result in the creation of 40 gpm of non-contact cooling water when boiler demand is as low as 16 gpm (Table 3-3).

Table 3-3
Water Usage During Re-Initiation of Steam Injection

Water Use	Ave. Flow Rate per Well (gpm)	No. of Wells	Total Water Usage (gpm)
Boiler Feed Water	2.5	16	40
Non-contact Cooling Water:			
- Extracted Liquid Cooling	0.8 to 2.9	7	5.6 to 20.3
- Extracted Vapor Cooling	0 to 2.9	7	0.0 to 20.3
Total Water Usage			Max. 40.6

4.0 PROJECT PLANNING DOCUMENTS

CH2M HILL. 1997a. Final Remedial Investigation (RI) Report for the Wyckoff Soil and Groundwater Operable Units, Wyckoff/Eagle Harbor Superfund Site, Bainbridge Island, Washington: Report to EPA Region 10.

CH2M HILL. 1998. Focused Feasibility Study for Thermal Remediation Technologies for the Wyckoff Soil and Groundwater Operable Units, Wyckoff/Eagle harbor Superfund Site, Bainbridge Island, Washington. Prepared for U.U. Environmental Protection Agency, Region 10, Seattle Washington. June 1998.

U.S. Environmental Protection Agency (USEPA). 2000. Record of Decision, Wyckoff/Eagle Harbor Superfund Site, Soil and Groundwater Operable Units, Bainbridge Island, Washington. Environmental Protection Agency, Region 10, Seattle, Washington. February 2000.

U.S. Army Corps of Engineers. 2000a. Wyckoff/Eagle Harbor Superfund Site, NAPL Field Exploration Comprehensive Report: Report to EPA Region 10.

4.1 EXISTING GROUNDWATER TREATMENT PLANT AND EXTRACTION SYSTEM OPERATIONS AND MAINTENANCE

- *Sampling and Analysis Plan, Wyckoff Facility and Groundwater Operable Units* (CH2M HILL 2000)

4.2 STEAM INJECTION PILOT SYSTEM PROCESS MONITORING

- *Thermal Pilot Study Monitoring Plan, Soil and Groundwater Operable Units* (USACE 2001a). Includes an overview of all monitoring to be conducted during implementation of the pilot study.

- *Work Plan for Thermal Remediation Pilot Project, Soil and Groundwater Operable Units* (USACE 2001b). Includes detailed methods for sampling and analysis during the first phase of the monitoring program, including further delineation of the extent of NAPL, physical characteristics of the contaminated media, and geologic/hydrogeologic properties of the subsurface.

- *Final Design Analysis Thermal Remediation Pilot Study, Soil and Groundwater Operable Units* (USACE 2001c). Documents the pilot study design efforts and includes information on the pilot study design, performance and compliance monitoring, system operations and maintenance, HAZOPS Analysis, project schedule, contracts, and the Preliminary Health and Safety Plan.

- *Final Design Analysis Amendment Thermal Remediation Pilot Study, Soil and Groundwater Operable Units* (USACE 2002a). Documents changes to the *Final Design Analysis.*

5.0 PROJECT SCHEDULE

The following list indicates the activities included in the project and their approximate duration:

- Pilot plant start up and commissioning: 09/16/02 to 11/01/02
- Active steam injection: 11/04/02 to 04/30/03
- Active liquid/vapor extraction during cool down with performance monitoring: 05/01/03 to 10/30/03
- EPA evaluation and decision on full-scale operations: fall 2003
- Groundwater pump and treat with ongoing monitoring: from 09/30/03

6.0 COMMUNICATION PLAN

6.1 CONTRACTOR SERVICES

Table 6-1 provides a list of all supporting groups and contractors plus the services they will be providing for this project.

6.2 COMMUNICATIONS STRATEGY

Accelerated approaches to sampling, analysis and operational decision making, as required for this project, integrate various tasks and measurements into a single coordinated effort. Accelerated approaches are conducted by a multidisciplinary group of experienced professionals, working as a team in several locations to evaluate the data and coordinate the activity between various government and contractor teams toward achievement of specific project objectives. Project team members and inter-group communication strategies are described below and shown on Figure 6-1.

6.2.1 Project Team

The project team consists of representatives from EPA Region 10, the USACE Seattle District Office, and numerous contractors. The project team provides the overall framework for the construction, operations, maintenance and data collection approach by defining project objectives and data quality requirements, and ensuring that both the objectives and data quality requirements are met during the execution of the Thermal Pilot Study.

Providing oversight for the project team throughout the process are individuals identified to ensure that project quality assurance/quality control and health and safety issues are addressed. At any time, any individual working on the project may contact the Industrial Hygienist, QA/QC Officer or the Health and Safety Officer to discuss project issues or concerns. It is the responsibility of the QA/QC Officer and the Health and Safety Officer to implement corrective actions if he/she feels project requirements are not being met.

The project team must keep the EPA RPM Mary Jane Nearman informed of how the project is proceeding. The approval of EPA is required for any major deviations in the work. Project updates will be given to the EPA RPM by the USACE PM (Kathy LeProwse) during regularly scheduled meetings, phone calls, e-mails or faxes. The RPM will consult and coordinate with other EPA project team members as necessary. The USACE PM is a member of the Operations Team (below) and will be in daily contact with the Site Manager.

6.2.2 Thermal Operations Team

Within the project team is a core technical team made up of individuals who have developed site-specific expertise in geologic, hydrologic, chemical analytical methods and operational approaches for the site. They provide a continual, integrated, and multidisciplinary presence throughout the process. The members of the core technical team form the primary operational team designated as the Operations Team. The optimization of field activities depend on the interaction among the members of the Operations Team and the EPA, each providing their own special perspective on the site.

The Operations Team oversees analysis of the raw data and recommends to the Operations Team Coordinator the next measurements that best meet project objectives. Members of the Operations Team should have whole-site-systems understanding of geology, hydrogeology, and contaminant chemistry. They work together to evaluate the data as they are obtained. Their most important role is integrating and understanding how data will be used to meet specific project goals. The ability to integrate their technical expertise with that of the other members of the core technical team is critical to the success of the project.

The Government Project Manager designates one Operations Team member as Operations Team Coordinator. The Coordinator shall coordinate and facilitate the team's decision-making process, ensuring that input is received from each member and other appropriate qualified sources. Every reasonable attempt shall be made to reach consensual team agreements; however if a consensus cannot be reached, the Government shall have final decision-making authority, exercised through the Operations Team Coordinator. Each Operations Team member shall have a designated backup member, who shall assume their responsibilities in their absence.

Based on earlier planning discussions, USACE PM Kathy LeProwse and EPA RPM Mary Jane Nearman had designated the Operations Team membership to include the following individuals:

Mary Jane Nearman – EPA RPM
Kathy LeProwse – USACE PM
Travis Shaw – USACE Site Manager
Mike Bailey – USACE Hydrogeologist
Brenda Bachman – USACE Monitoring Coordinator
Cliff Leeper/Joe Harrington – SCS Engineers (O&M Contractor)
Gorm Heron – Steamtech, Inc. (Expert Consultant)

The Operations Team (Ops Team) members have defined the primary role of the team as the decision making body responsible for daily operational decisions during thermal remediation. The Ops Team members will review project data and convene mid-morning each workday to review monitoring and process data. The Ops Team Coordinator will provide a summary of the data and report system status at the beginning of each daily Operations Team meeting. The Ops Team will then decide on operational objectives for the next 24-hour period. Once the operational goals for the project are decided, the Ops Team Coordinator will direct the Contractor (SCS Engineers) to implement the decisions of the Ops Team. The decisions and directions provided to the Contractor will be documents in a daily Operations Team Meeting Summary and will be disseminated to the larger Thermal Remediation Pilot Technical Support Team via e-mail. The daily meeting summary will also be posted to the project web-site.

The primary role of the Technical Support Team will be to provide technical expertise and advice to the Ops Team. As noted above, members of the Technical Support Team may serve on the Ops Team, at the request of the Project Manager, at times when regular participation is required to resolve reoccurring or consistent issues. For example, if treatment plant breakdowns impact operations, a Process Engineer may be added to the Ops Team to help resolve technical problems, provide advice, and assist in making sound operational decisions. Technical Support Team members will be expected to review project data on the website on a regular basis and stay current regarding on-site developments and progress.

Operations Team- Individual Roles and Responsibilities

EPA Remedial Project Manger (RPM) Mary Jane Nearman: The RPM is the EPA authority for this project. The RPM will approve all recommendations regarding cost and scope variations prior to implementation. The RPM is also responsible for assuring that all functional criteria or the Thermal Remediation Pilot Project are met during conduct of this project. The RPM must be kept informed of progress on a regular basis and will have a decision weigh-in at significant project milestones.

Backup: Sylvia Kawabato (EPA)

USACE Project Manager (PM) Kathy LeProwse: The PM will maintain specific project management authority throughout the life of the project, and is responsible for overall management and execution of the project to include project quality, cost and schedule. Specific tasks include:

- Providing the project team with funding for each task
- Tracking and reporting to EPA financial expenditures, obligations and schedule
- Ensure that EPA's goals and objectives for the project are achieved.

Backup: Travis Shaw

Site Manager / Ops Team Coordinator Travis Shaw: The Site Manager is responsible for the overall performance of the field work, including adherence to the Sampling and Analysis Plan, change orders, scheduling, liaison with EPA, and sample logging and custody. The Site Manager is responsible for the thorough, smooth and efficient coordination between various on-site contractors, sub-contractors the treatment plant operators. The Site Manager will also function as the Site Health and Safety Officer, and will be responsible for the safe operation of the field and laboratory teams. He will be responsible for implementation of the Health and Safety Plan for the entire site, review its contents with all personnel, confirm that all personnel have received the required health and safety training, determine personal protection levels, provide necessary personal protective equipment and supplies, and correct any unsafe work practices.

To the extent practicable, the Site Manager will coordinate field decisions regarding field activity and thermal operations with the Operations Team.

During fieldwork when the RPM is not present, the Site Manager will be responsible for responding to direct requests from members of the community or others for information on current field activities at the site. A record of such communication shall be maintained and forwarded to the USACE Project Manager and the RPM. When requested by the EPA RPM, the Site Manager will serve as EPA's on-site representative.

Backup: Kathy LeProwse
Project Hydrogeologist Mike Bailey: The project hydrogeologist will evaluate geologic and hydrogeologic conditions, movement of fluids, heat and contaminants in the subsurface. He will perform and/or oversee modeling activity, aquifer testing, and groundwater extraction or infiltration. The hydrogeologist will also be the lead for data presentation and synthesis of data into GMS.
Backup: Gorm Heron

Monitoring Coordinator Brenda Bachman: The Monitoring Coordinator will provide oversight and coordination for all process, compliance and remedy effectiveness monitoring to be conducted by contractors for the Thermal Remediation Pilot Study. She will assist Project Chemist in developing of data quality objectives, selection of analytical methods and laboratories, approval of quality assurance/quality control (QA/QC) procedures, and review of daily field reports.
Backup: Steve Meyerholtz for thermal/Pilot Area monitoring; Sarah Bates for Treatment Plant monitoring

6.2.3 Design/Technical Support Team

The project support team includes technical personnel and equipment operators involved in data collection, engineering and sampling personnel who provide other support functions.

Project support team members include:

- USACE Process Engineer – Marlowe Dawag
- USACE Instrumentation/Sub-Surface Monitoring – Steve Meyerholtz
- USACE Mechanical Engineer – Sven Lie and Anne Marie Moellenberndt
- USACE Electrical Engineer – Cynthia Masten
- USACE Civil Engineer – Pat Naher

- USACE Industrial Hygienist – Kim Calhoun

- USACE Chemical/Field Support – Sarah Bates

- Off-Site Laboratories:
    - EPA Region 10 Manchester Environmental Laboratory: Gerald Dodo
    - EPA Office of Research and Development: Marta Richards
    - Core Laboratories, Inc.: Jeff Smith
    - PTS Laboratories, Inc.: Richard Young
    - Environmental Resource Associates, Inc.: Joel Holtz
    - Southwest Laboratory of Oklahoma Inc.: Barbara Forrester
    - EPA CLP Laboratory: TBD
    - SCS Contract Biomonitoring Laboratory: TBD
    - SCS Contract Water Quality laboratory: TBD

- Geoprobe Team: EPA Manchester Lab ESAT Team

- SCS, Inc.: David Roberson

- Pease Construction, Inc.: Loren Pease

- URS Corporation: Ty Griffith

- Sensa, Inc.: Gary Harkins

The project support team will be in daily contact with the Site Manager, or designated technical task manager, when they are working on site. They may be asked to attend technical team meetings to present results or other technical issues, if needed. Off-site laboratories will be contacted by the Site Manager, or designee, as necessary.

6.3 SYSTEMS OPERATIONS DATA FLOW

As presented in Section 1.1, data from the pilot study will be used to support three broad objectives: performance assessment, community and environmental impacts evaluation, and process monitoring. Data must be generated, managed, and reported in a manner that supports these objectives and the accelerated approach to sampling, analysis and operational decision making required for this project.

There are three sources of data for this project:

- Electronically monitored instrumentation (USACE)
- Manual read and recorded on field forms (SCS)
- On-site and off-site laboratory data (SCS and URS)

These data will be managed directly by the data generators (USACE, SCS and URS) and reported in various formats to support the project objectives. The flow of information from data sources through the different data management tools and the project website are discussed below and shown in Figure 6-2.

6.3.1 Process Monitoring

Data used for process monitoring will be loaded onto the project website on a daily basis for use by the Ops Team. These data includes a subset from all three data sources identified above. Because the Ops team will only be using these data for daily operations decisions and not for formal data analysis, statistics, or reporting, all files will be in non-manipulatable portable document format (pdf). SCS and URS will create pdf files as described in the Data Management Plan (Section 9.0) and save them to the USACE file transfer protocol (ftp) webpage (ftp://ftp.nws.usace.army.mil/pub/Wyckoff%20Thermal/). USACE will then load the information onto the website (http://www.wyckoffsuperfund.com/) for access by the Ops team.

6.3.2 Performance Assessment and Community and Environmental Impacts Evaluation

Data used for performance assessment or community and environmental impacts evaluation will be summarized in formal reports at the completion of the thermal pilot study. The data needed for these evaluations is a subset from all three data sources identified above. Because the Ops team will be using these data for formal data analysis, statistics, and reporting, data must be managed in an accessible, manipulatable format. All data generated for this project will be stored by USACE, SCS, and URS in spreadsheets or a relational database (e.g., Microsoft Access). At the completion of the study, these datasets will be turned over to the USACE and EPA for use in assessing the performance of the treatment system and in producing reports for demonstrating compliance with applicable regulations (e.g., air quality and effluent discharge).

Table 6-1
Wyckoff Thermal Remediation Pilot Study
Supporting Groups and Contractors

Support Groups/ Subcontractor	Service	Address and Contact
USACE Seattle District	Location surveying	4735 East Marginal Way South Seattle, WA 98134 Contact: Anita Wong (206)764-3535
SCS, Inc.	Operations and maintenance contractor	2405 140th Avenue NE, #107 Bellevue, WA 98005 Contact: David Roberson (425)746-4600
Pease Construction, Inc.	Pilot system construction and start up	3815 100th St. SW, #3A Lakewood, WA 98498 Contact: Loren Pease (253) 584-6606
URS Corporation	Sampling and analysis of perimeter, source and fugitive air emissions	1501 4th Avenue Seattle, WA 98101 Contact: Ty Griffith (206) 343-7933
Sensa, Inc.	Installation support for DTS system	Contact: Gary Harkins (661) 834-7015
Drilling Service	Soil boring and monitoring well installations	TBD
EPA Region 10 FASP	On-site soil analyses for TPH-Dx, PCP, and PAHs	7411 Beach Drive East Port Orchard, WA 98366 Contact: Neal Amick 360-871-8787 Gerald Dodo 360-871-8728
EPA Region 10 CLP	Groundwater Analysis for Water Supply Well Sampling	TBD
EPA Region 10 CLP	Soil Analysis for SVOCs	Liberty Analytical Corporation 501 Madison Avenue Cary, NC Contact: Alice Evans
Environmental Resource Associates	Performance evaluation samples	5540 Marshall Street Arvada, CO 80002 Contact: Joel Holtz 303-431-8454
PTS Laboratories, Inc.	Residual Saturation of NAPL in upper aquifer soils	8100 Secura Way Santa Fe Springs CA 90670 Contact: Rick Young 562-907-3607
EPA Region 10 Manchester Environmental Laboratory	Soil analyses for TPH-Dx and SVOCs	7411 Beach Drive East Port Orchard, WA 98366 Contact: Gerald Dodo 360-871-8728
Core Laboratories, Inc.	Thermal capacity and thermal conductivity testing of upper aquifer soils	3430 Unicorn Road Bakersfield, CA 93308 Contact Jeff Smith (661) 392-8600

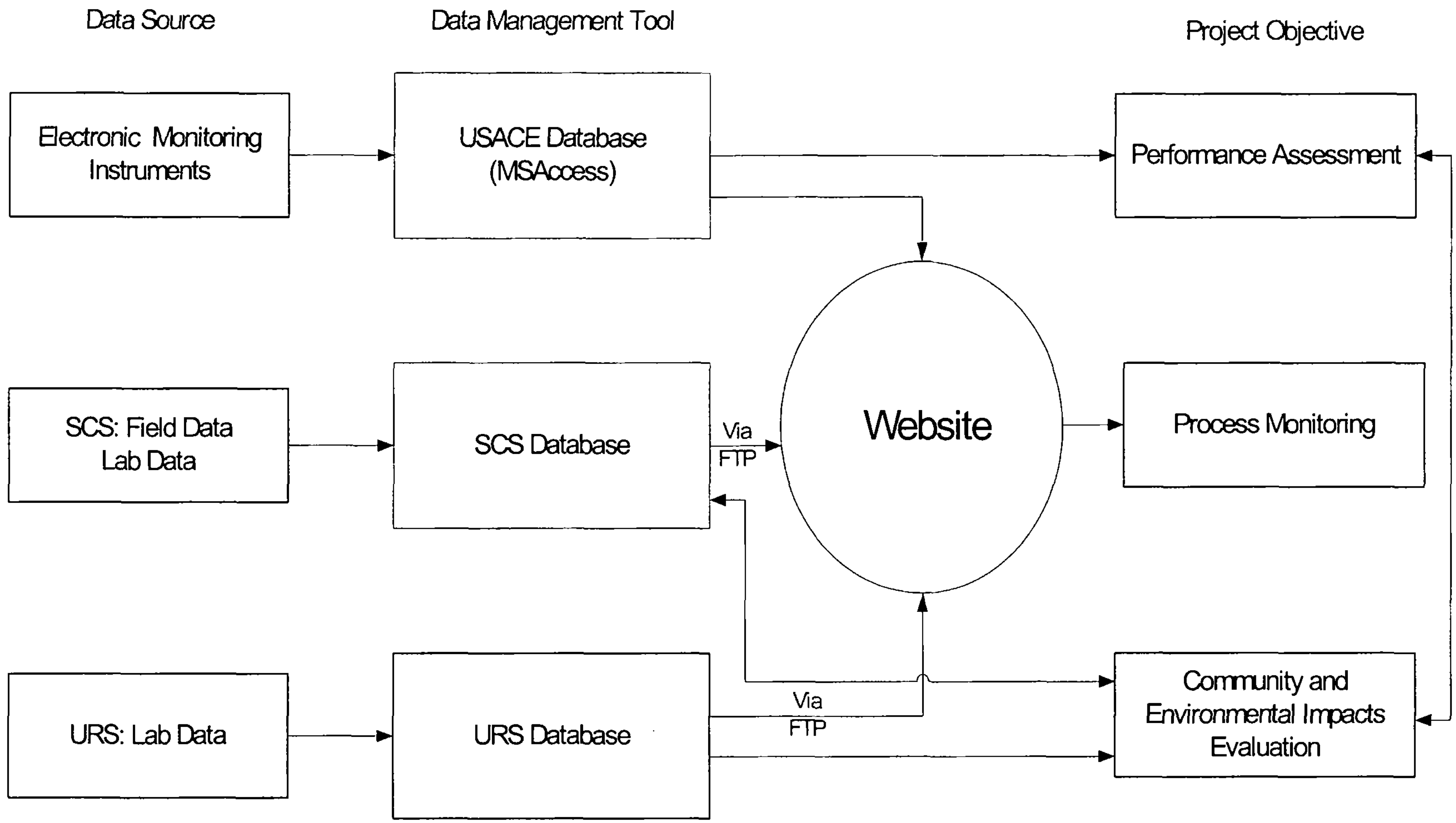
Support Groups/ Subcontractor	Service	Address and Contact
USEPA Office of Research and Development (Battelle Memorial Institute and Microbial Insights, Inc.)	Soil analysis for microbiological baseline testing (microcosm studies and phospholipid fatty acid (PLFA) analyses)	Engineering Technical Support Center Marta Richards (513) 569-7692
Southwest Laboratory of Oklahoma Inc.	Soil analysis for dioxin/furans	Barbara Forrester 1700 West Albany Broken Arrow, OK 74012-1421
EPA Manchester Environmental Lab ESAT Team	Push-probe sampling	7411 Beach Drive East Port Orchard, WA 98366 Contact: Terry Fowler 360-871-8794

Figure 6-1: Wyckoff Thermal Remediation Pilot Study Staff Organization/ Communication Plan

- MaryJane Nearman — EPA RPM
  - Kathy LeProwse — USACE PM
    - Tim Grube — District Safety Officer
    - Travis Shaw — Site Manager/PE/Site Health and Safety Officer
      - Brenda Bachman — Monitoring Coordinator
        - A&E / Laboratory Support
          - URS/Radian — Air and Noise Monitoring
          - Core Laboratories — Thermal Testing Lab
          - PTS Labs — Saturation Testing
          - TBD — CLP Laboratory
          - Southwest Labs — Dioxin/Furans Analysis
          - *Gerald Dodo and Chris Hall* — EPA Laboratory Coordinator and EPA QAMS
        - Steve Meyerholtz — Instrumentation/Data Management Lead
          - Instrumentation Support — Andrejs Dimbirs, Lisa Adamo, Suzie Hess, Lawrence Lin, Dave Gustafson, Larry Mann, Mike Bailey
          - Sensa — DTS Contractor
          - Dennis Gunderson — Geomation Contractor
        - Field Geologist — Performance Assessment Field Lead
          - Gerald Dodo — EPA Lab Coordinator
            - Geoprobe Team — EPA FASP Team
            - Neal Amick — FASP Laboratory
      - Bill Brooker (ACO) — USACE Construction Contract Adm. (Pease)
        - Hank Payne — QA Representative
        - Mike Cristler — Office engineer
        - Pat Guire — Contract payments
        - Doug Ramsey — Shop Drawing/Submittals
      - Ginny Dierich (COR) — Service Contract Adm. (SCS)
        - Kathy LeProwse — WADS Administrator
        - May Carrell — WADs Accounting
    - Thermal Operations Team — Operation Team Coordinator - Travis Shaw
      - EPA RPM: Hanh Gold
      - USACE PM: Kathy LeProwse
      - USACE Monitoring Coordinator: Brenda Bachman
      - USACE Hydrogeologist: Mike Bailey
      - *O&M Contractors:* Cliff Leeper/ Joe Harrington
    - Design/Technical Support Team
      - Hydrogeologist: Mike Bailey
      - Monitoring: Brenda Bachman
      - Process Engineering: Marlowe Dawag
      - Sub-Surface Monitoring: Steve Meyerholtz
      - Mechanical Engineer: Sven Lie
      - Electrical Engineer: Cynthia Masten
      - Civil Engineer: Pat Naher
      - Industrial Hygienist: Kim Calhoun
      - Chemistry/Field Support: Sarah Bates
      - Consultant: Steamtech

Shaded areas delineate those tasks finished during pilot area construction phase.
Non-shaded areas will continue through thermal remediation operations and maintenance.

Figure 6-2: Operational Systems Data Flow



7.0 MONITORING PLAN

7.1 INTRODUCTION

The Wyckoff Thermal Pilot Study monitoring program is designed to meet the nine primary objectives of the study described in the Record of Decision (ROD) for the Soil and Groundwater Operable Units (OU's) (Section 1.1). In addition, monitoring to demonstrate substantive compliance with local, State and Federal environmental regulations will be addressed.

The design of the Pilot Study monitoring program follows the Corps of Engineers Technical Planning Process (TPP) as described in EM 200-1-2 (August, 1998). The TPP provides a framework for the systematic identification of project objectives and helps ensure required types, quantity and quality of data are obtained to meet the project objectives. The TPP is also consistent with EPA's 7-Step Data Quality Objective Process.

The TPP begins with the identification of project objectives (Tables 8-1 and 8-2). Project objectives are also classified by data user category and data classification (Table 8-3). Next, data users are identified by category (Table 8-4). For the technical planning process to succeed, it is critical that data users provide input to monitoring plan designers to ensure that project objectives and data requirements to meet those objectives are identified.

Data quality objective worksheets are then prepared for each data user perspective. These worksheets compile data type, data use, specific project objectives met by the data and required sensitivity (if determined). At this stage of the project, only remedy effectiveness and compliance perspective worksheets have been developed. As the project progresses it will become important to complete data quality worksheets for both risk and responsibility perspectives.

1.1 CONSTRUCTION PHASE INVESTIGATION

Installation of the thermal remediation system within the Pilot Study treatment area provided an opportunity for baseline conditions to be assessed prior to steam injection. Extensive sampling during the drilling of extraction and instrument wells enabled the extent of contaminated soil and NAPL to be determined with exacting precision and accuracy. This robust delineation will provide greater flexibility during the Performance Assessment phase of the project and enable EPA to determine how successful the Pilot Study was in meeting the performance expectations. If the Pilot Study is successful in meeting the performance objectives, the expanded delineation will also allow for an assessment of operational procedures intended to optimize NAPL recovery and soil remediation. These lessons will have direct utility during full-scale operations.

During construction, the Region 10 FASP Team collected continuous samples at each of the 14 extraction and 77 instrument wells using the Geoprobe 5400. In an effort to reduce the number of total samples collected and analyzed, potential sample collection during the installation of the injection wells was not included. Previous experience at thermal remediation sites indicates that subsurface zones that receive increased volumes of steam have the greatest probability of meeting remediation goals. It is assumed that soil in the immediate vicinity of injection wells will receive the most steam during active remediation and will most likely meet performance expectations. Consequently, a more complete evaluation of the effectiveness of thermal remediation will be made at locations further away from the location of steam injection represented by the instrument and extraction wells.

1.2 PERFORMANCE AND COMPLIANCE MONITORING

The fundamental process used in thermal remediation is to add thermal energy to the subsurface to aid in the recovery of NAPL and contribute to the actual destruction of NAPL constituents in the upper aquifer. Destruction of contaminants occurs through a combination of physical and chemical processes including enhanced biodegradation and hydrous pyrolysis oxidation (HPO). Not surprisingly, it is important to track the movement of heat throughout the treatment area in order to operate the recovery process effectively. This is particularly true when the objective is to describe and evaluate the extent of conductive and advective heating and or steam front movement through the treatment area.

Success of the thermal pilot study will require careful monitoring of subsurface conditions in order to ensure that each of the performance expectations is achieved. One of the key features of the monitoring program is the collection and interpretation of thermal data within the Pilot Study Area. A rigorous monitoring program will ensure that the project operations team has sufficient data to operate and optimize the thermal remediation process and evaluate operational approaches, which may impact removal of NAPL. Elements of the process monitoring program include thermal logging, steam and liquid flow monitoring, and pressure monitoring.

The Pilot Study design includes 16 injection wells, 7 extraction wells, and 64 dedicated instrument strings. These data will be used to maintain a total heat budget for the Pilot Study. The location of the wells and monitoring points are shown on Figure 7-1.

7.1.1 Subsurface Thermal Monitoring

Thermal monitoring in the subsurface provides data for the evaluation of heating effectiveness and helps determine the location and direction of steam fronts. When combined with wellhead extraction and flow data, thermal monitoring will also help evaluate heat flow patterns and identify areas requiring focused thermal treatment.

There are a total of 636 individual monitoring points in the injection and extraction wells and the temperature strings. Thermocouples will be used to monitor at 467 points, and the remaining 169 points will be monitored with a fiber optic distributed temperature system (DTS). The DTS system consists of a continuous loop of specially coated optical fiber installed inside a ¼" O.D. tubing which is grouted and backfilled in place. The ends of the optical fiber are connected to an opto-electronic readout unit on the surface. Temperature is measured by sending a pulse of light down the optical fiber causing molecular vibration, which is directly related to temperature. The molecular vibration creates a weal reflected signals detected by the surface read-out unit at the surface and converted to values of temperature at one-meter intervals along the entire length of the fiber. A thermocouple string was installed along with the DTS fiber in instrument string T7, in order to verify the DTS accuracy, reliability, and calibration.

The thermocouples used for the subsurface monitoring of temperatures will be type E. Type K would also be acceptable, but type E was selected because it produces a higher voltage per degree output (better resolution) and is more repeatable in thermal cycling over the temperature range. The two metals used in type E are Constantan and Chromel. The other two standard types, J and T, were not considered because they use iron and copper conductors respectively and are thus more susceptible to corrosion.

Typical monitoring well details are shown on Figure 7-2.

Injection Wells

Three thermocouples are located in each injection well; at the top, middle, and bottom of the screen. The thermocouples were backfilled and grouted in the annular space between the drill casing and the steam injection casing. The position of the thermocouples will assist the operations team in verifying the vertical distribution of steam and confirm that steam is injected at the bottom of the screen and not just the upper portion.

Extraction Wells

The extraction wells will be monitored with the DTS. The fiber was grouted and backfilled in the annular space between the drill casing and the screened extraction riser. The bottom of the DTS fiber therefore, is 1 ft above the bottom of the well sump (approximately 4 ft beneath the top of the aquitard).

Temperature measurement at the extraction wells will be used to develop steam break-through curves to determine liquid extraction rate adjustments. The placement of DTS temperature measurement points below the top of the aquitard will allow the operations team to confirm that steam is sweeping along the top of the confining layer and increasing the effectiveness of NAPL removal along the interface between the upper aquifer and the aquitard.

Temperature will also be measured at the wellhead to assist the operations team in evaluating steam breakthrough during pressure cycling. Extracted liquid temperature is also an important parameter for the calculation of heat lost from the system and will be used to document enthalpy.

Instrument Strings

Temperature will be monitored in vertical strings in 64 locations in addition to the injection and extraction wells. Thirty-six of the instrument strings will be monitored with thermocouples and 41 with DTS. The bottom sensor or fiber is located at the top of the aquitard. Maximum spacing for the thermocouples will be 1.5 meters with an additional monitoring point placed mid-way between the lowest thermocouple and the thermocouple located 1.5 meters above the top of the aquitard. The uppermost measurement point is in the middle of the collection layer. These dedicated instrument strings will allow the operations team to document balance heating in the treatment area. The horizontal and vertical spacing of thermocouples is required to determine that all areas are receiving adequate steam. Combined with a measurement accuracy of < 2° C, the operations team will be able to identify areas being heated by hot water rather than steam and adjust injection rates at individual wells to balance steam flow through the subsurface. The tight spatial distribution of monitoring points measured daily will enable the operations team to evaluate pressure cycle frequency and duration to optimize contaminant recovery (Section 3.2)

Subsurface temperature monitoring is required to calculate the total enthalpy of the subsurface for energy balance calculations. These calculations will assist EPA in the final assessment of the Pilot Study by providing data for estimating the total number of pore volumes of steam injected into the treatment area. The Performance Assessment described in Section 8.5.1, which focuses on evaluating how well the Pilot Study has met performance expectations in the ROD, relies on an estimate of injected steam pore volumes. Energy balance calculations will be vital in determining the cost effectiveness of thermal remediation technology at the Wyckoff site. Temperature data will also assist the operations team in predicting fuel usage as the project progresses.

7.1.2 Pressure Monitoring

There are a total of 75 pressure monitoring points. Additionally, pressures will be monitored at the vapor cap collector system.

Injection Wells

The pressure in the steam line will be monitored near each injection well. The pressure will be an output from a differential pressure flow meter that will have a 4-20 mA transmitter. The transmitter will have outputs for flow, pressure, and temperature. Pressure measurements will be used to verify flow measurements and prevent damage to the well and conveyance system.

Extraction Wells

The pressure in the vapor line will be monitored near each extraction well. The pressure will be an output from a differential pressure flow meter that will have a 4-20 mA transmitter. The transmitter will have outputs for flow, pressure, and temperature. At the wellhead, pressure data will be used by the operations team to document the vacuum in the system and the change in pressure during pressure cycling (Section 3.2).

A vibrating wire pressure transducer was installed down-hole, at ½ meter below the aquitard surface and was grouted with the DTS fiber. These down-hole instruments will enable water levels to be determined during thermal treatment. Accurate water level data is important to control the liquid phase extraction rate and assists in documenting hydraulic control of the treatment area. When combined with contaminant extraction data, water level data will support operation decision-making by confirming if NAPL migration is encouraged during limited draw down conditions.

Installation of the vibrating wire transducer within grout at the bottom of selected extraction wells will allow accurate water level measurements without silting or other failures documented in previous thermal projects. The selected transducers are capable of responding to a 1 psi change in pressure measured by an inflow of 2×10^{-5}ml of water. This volume of water is available within the grouted flow path between the formation and the tip of the instrument. Since the transducer is secured within grout, it is protected from silting or physical displacement that may occur during steam injection and measurements will not be impacted by the flow of liquids in the formation.

Instrument Strings

A vibrating wire pressure transducer will be grouted in at the top of the aquitard in 9 of the instrument strings, designated on Plate GT-1 in the final thermal remediation pilot operations and maintenance plans (USACE 2001c). These pressure measurements will augment the data from down-hole transducers in the extraction wells to document hydraulic control of the treatment area.

7.1.3 Flow Monitoring

Flow will be monitored in the steam injection line and vapor extraction lines (see above) at the wellhead. Vapor flow rates will be used by the operations team to maintain energy balance calculations and identify wells requiring service. Flow will also be monitored in the liquid extraction line with a meter that will supply a 4-20 mA output, and at several locations in the liquid treatment plant and the non-condensable vapor treatment system. Additionally, flows will be monitored in the vapor cap collector system.

Flow data from the liquid extraction wellheads will be used by the operations team to evaluate the function of down hole pumps and determine the frequency of maintenance. In addition, this data will be used to document the water balance across the treatment area. When combined with wellhead chemical data, liquid flow data will enable the operations team to track the mass balance recovered from each well and evaluate strategies for the optimization of contaminant recovery during pressure cycling.

7.1.4 Data Collection and Management

Two data collection systems will be used to collect and process data from the field instruments. Data from the DTS readout unit will be collected and stored on a potable on-site personnel computer (PC) in binary format and converted to ASCII format. All thermocouples, vibrating wire pressure transducers and flow meters will produce 4-20 mA output that will be monitored by a Supervisory Control and Data Acquisition (SCADA) system. The components of the SCADA system include a PC (the same PC used with the DTS system), remote terminal units

(RTU) and input/output (I/O) modules. A SCADA system is a host driven data collection system. Data from the RTUs and I/O modules is only sent to the PC in response to a poll from the PC. Software running on the PC will be used to program the required reading schedules and to reduce the raw data to engineering values.

The RTU is a base controller unit providing a Modbus compatible communication port. Seven RTUs will be distributed around the site in NEAM 4 enclosures, each capable of connecting to as many as 60 I/O modules. One module will be required for each vibrating wire and 4-20 mA sensor. Two thermocouples can be connected to a single module. The NEAM 4 enclosures for both the RTUs and the I/O modules will either be mounted on a 4x4 wooden post or to the side of the cable tray.

Communication from the PC to the RTUs will occur over an opto-isolated RS485 wireline digital link. The communication between an RTU and its modules will occur over a 4-conductor bus extension cable that will carry both data and power. These connections will also be opto-isolated. The opto-isolation of all field communication connections will provide sufficient surge protection. Data from the SCADA system will be stored in SQL database on the PC. A query will extract and format data from the data base and store the data in the same format used for the DTS ASCII files.

Data from the instrumentation system will be collected daily via modem by Seattle District and on-site contractor staff. Data will subsequently be plotted using off-the-shelf graphics and data visualization software and posted to a web site for review. Temperature, flow and pressure data will also be entered into dedicated spreadsheets for use in reporting total enthalpy and other operational parameters for use by the operations team.

6.2 SUBSURFACE CONTAMINANT REMOVAL RATE MONITORING

7.1.5 Extracted Liquid and Vapor Removal and Analysis

As discussed in Section 8.3.3 (Flow Monitoring), the flow of liquid and vapor will be measured at each extraction well to provide data for mass balance calculations and for use by the operations team for process control. The extraction well influent streams (liquid and condensed vapor) will be combined prior to entering the treatment plant. Total Organic Carbon (TOC) concentrations will be measured at this junction to provide a measurement of total hydrocarbon extracted. This data will be used for mass balance calculations and to aid the process operations team in identifying variations in recovery efficiency. TOC will be monitored continuously with an in-line instrument. TOC measurements will be augmented by periodic analysis at a fixed lab for PAH and PCP to provide a more complete analytical picture of influent characteristics and treatment plant performance.

7.1.6 Condensate Production Rate and Non-Condensable Flow Rate

The vapor streams from individual extraction wells will be combined in the conveyance system and pass through a condenser prior to reaching the treatment plant. After the condenser, two flow rates will be determined. One flow rate measured will be the total condensate production, and will be measured by a standard, industry meter. The second flow rate is of the non-condensable gases passing through the condenser. These two flow rates are used in support of overall mass balance and heat flux calculations.

7.1.7 Condenser Temperature Monitoring

The temperature drop across the condenser is also measured and is complementary to the flow rate, mass balance and heat flux calculations. Additionally, the temperature drop monitoring is necessary for process control of the condenser and is also helpful in monitoring condenser effectiveness.

7.1.8 Non-Condensable Gases Stream Analysis

The non-condensable gases will undergo full-analysis to determine the constituents and their concentrations before going to the boiler for energy reclamation or the vapor phase activated carbon units. Carbon dioxide will be specifically tested for in the full-analysis. Carbon dioxide is the significant parameter for determining mass balance calculations and provides data to evaluate the extent of the biologically enhanced degradation of contaminants.

7.1.9 Volumetric Measurement of Product from the Dissolved Air Flotation

The Dissolved Air Flotation (DAF) tank will be the primary NAPL recovery step in the treatment plant. The volume of product recovered by the DAF will be determined by pumping recovered NAPL to the product storage tank, T-105, with a volume of 10,150 gallons. The height of the product in the tank will be determined using a physical measuring device. The tank volume should be measured at least daily during the pilot study to provide an average daily NAPL recovery rate and support mass balance calculations.

7.1.10 Final Effluent Analysis

The final effluent stream must undergo full-analysis for all contaminants of concern to show compliance with RCRA, NPDES permitting requirements and provide data for evaluating treatment efficiency Final effluent analysis data will also be used to complete mass balance calculations.

1.3 REMEDY EFFECTIVENESS MONITORING

Remedy effectiveness monitoring includes a broad range of data collection activities to address two different project objectives. The first objective is gather data on the chemical and physical characteristics of the Pilot Study area before, during and after thermal treatment to evaluate the performance of thermal treatment in meeting the Pilot Study expectations summarized in

Section 1.0. Remedy effectiveness monitoring will also address broader issues regarding treatment plant efficiency, process optimization and full-scale design issues not captured by other facets of the monitoring program.

7.1.11 Performance Assessment

The performance assessment portion of the monitoring program will be focused directly on demonstrating how well the Pilot Study met EPA's performance expectations described above. The successful demonstration that the performance expectations have been reasonably achieved will assist EPA in determining if the increased capitol costs of implementing full-scale thermal remediation at the site are justified.

One of the greatest challenges to demonstrating that the Pilot Study has attained each of the performance objectives is that the treatment area will retain heat beyond the time frame EPA has set to make a decision on implementation of full-scale treatment. Consequently, NAPL mobility and groundwater concentrations of NAPL constituents will remain higher during the performance evaluation period (the six months after steam injection is complete) than after the site returns to ambient temperatures. Consequently, the attainment of first two performance objectives will require data collection and analysis that allows valid inferences regarding future site conditions.

7.1.12 Demonstration of Mobile NAPL Removal

The demonstration that substantially all mobile NAPL has been removed from the Pilot Study area will require a weight of evidence approach using a variety of data collection strategies during each phase of the project. The installation of injection, extraction and instrumentation wells provided an opportunity for increased delineation of NAPL zones within the Pilot Study area. Each of the wells was logged continuously during construction and the presence of residual or mobile NAPL was recorded. Soil samples for chemical analysis of Total Petroleum Hydrocarbons (TPH), PAHs and PCP were collected from discrete sections of each drilling interval containing obvious contamination. The resulting data was incorporated into detailed cross-sections of the pilot treatment area for use in selecting performance assessment sampling locations after thermal treatment.

The construction phase investigation also allowed collection of undisturbed samples for residual saturation determination. Residual saturation (S_r) of NAPL is the saturation (volume of NAPL/volume of voids within the soil matrix) at which NAPL becomes discontinuous and is immobilized under ambient groundwater flow conditions (Mercer and Cohen 1993). It is important to remember that the properties of NAPL flow are different than a dissolved plume. As gravity forces NAPL to migrate vertically through the soil matrix, surface tension effects will trap some liquid product within pore spaces. These isolated globules will continue to be a source of dissolved phase contamination to groundwater; however, the isolated globules will remain immobile unless there is a change in the prevailing hydraulic conditions. Site-specific residual saturation data prior to remediation will be compared to post-treatment data to determine if NAPL zones that may persist after thermal treatment represent mobile or residual NAPL.

Once thermal treatment is initiated, the most straight forward line of evidence that substantially all mobile NAPL had been removed will be the gradual decrease and eventual cessation of NAPL collected at the treatment plant combined with decreasing TOC concentrations in the conveyance and treatment system. Under ambient conditions, the lack of NAPL in an extraction system is usually a poor indicator of NAPL presence. However, since thermal treatment will alter the density and viscosity of the product resulting in increased mobility, reductions in recovered product provide more compelling evidence that mobile product has been substantially removed.

The next line of evidence used to demonstrate NAPL removal will be to evaluate the extent of hydrocarbon contamination in Pilot Study area soils after thermal treatment. This determination will be made by comparing chemical concentrations in soil samples collected before and after thermal treatment. Direct soil sampling locations were selected to represent the range of stratigraphy and contaminant levels observed during the installation of treatment system wells (steam injection and extraction wells and instrumentation wells). At the same time, undisturbed co-located samples were collected and preserved to determine average hydrocarbon saturation. If the chemical analysis results confirm the presence of hydrocarbon concentrations above 8,000 mg/kg, then the saturation results will be used to determine the percentage of hydrocarbon saturation in the co-located sample. This last step is required to demonstrate that any confirmed hydrocarbon contamination left within the Pilot Study area does not constitute mobile NAPL. The residual saturation threshold proposed for this determination is currently 0.25. This value reflects a conservative estimate of non-mobile product inferred from site-specific data, but may be changed based on laboratory tests.

The exact number of soil samples is difficult to estimate at this time since the sample location selection will rely on data gathered during active thermal remediation in the Pilot Study area. The interpretation of the chemical and physical properties analysis will also include subsurface data collected during the operational phase of the Pilot Study. For example, if direct soil sampling results in a previously identified NAPL zone indicate high levels of hydrocarbon contamination and NAPL saturation estimated above 0.25 remain after thermal treatment, it will be important to verify that the sample location received sufficient heating. A sample containing mobile NAPL from a location that thermal monitoring data suggests received only one or two pore volumes of steam condensate should not be considered a failure to meet the performance expectations. Conversely, a sample containing hydrocarbon contamination indicating a measured saturation above 0.25 collected from an area that subsurface thermal monitoring indicated received at least three pore volumes of steam condensate would not meet the performance expectations.

7.1.13 Demonstration That Dissolved Phase Constituents Attain Performance Expectations

The demonstration that dissolved phase NAPL constituents will meet surface and marine water quality criteria and sediment quality criteria at the mud line is also complicated by the retention of heat in the thermal treatment area. The solubility of NAPL constituents will be higher immediately after steam injection for up to two years after active treatment. Consequently, the demonstration that any residual hydrocarbon contamination will impact upper aquifer groundwater release to surrounding marine water will rely heavily on predictive fate and transport modeling. Data collected during the soil sampling described in the previous section can provide expected residual contamination data for the model. In addition, a groundwater sampling program will be initiated as the site cools to confirm that the anticipated reductions in contaminant concentrations will occur with cooling. Site cooling is predicted to be rapid during the first two months after completion of steam injection. Groundwater data will be collected from 6 representative wells from across the site approximately two months after active steaming. Current thermal modeling data suggests that the site temperatures will have decreased by 50% within that time frame. Parameters of interest and desired sensitivity are presented in Table 3.2, Appendix E, of the final thermal design analysis (USACE 2001c).

An important component in meeting groundwater remediation goals is enhanced biodegradation. Theoretically, in-situ degradation activity will be increased in the Pilot Study area for months after active thermal processes cease. This enhanced activity is thought to result from a combination of super-saturated contaminated groundwater concentrations accompanied by a temperature induced increase in microbial metabolic reactions. Site specific data has already demonstrated that site soils subjected to steam injection retain metabolically active microbial populations (Richardson 1999). However, whether the post steam microbial community is capable of degrading PAHs has yet to be determined.

Soil sampling will be conducted to allow for a comparison with pre-treatment microbial population enumeration and identification. Conceptually, Polymerase Chain Reaction (PCR) methods will be used to evaluate changes in the microbial community before and after thermal treatment. Soil will be incubated under post thermal treatment conditions and spiked with representative radio-labeled PAHs to verify the persistence of PAH degraders. The use of radio-labeled PAH tracers will also allow for the rate of PAH degradation to be estimated. The measured residual contaminant levels, as well future levels estimated from measured degradation rates, will then be used in the groundwater modeling effort to evaluate whether any residual soil contamination will prevent achievement of groundwater remediation goals at the shoreline adjacent to the Wyckoff facility.

7.1.14 Demonstration That Surface Soil Attains MTCA Method B Cleanup Levels

Achievement of the final pilot study performance goal is probably the easiest objective to evaluate. Vadose zone soil from the pilot study area will be sampled directly with direct push techniques and submitted for analysis by the Region 10 Laboratory at Manchester, WA. Fixed laboratory methods will be required to achieve the required reporting limits for comparison with the Department of Ecology's MTCA Method B clean up levels. A direct comparison between the MTCA clean up levels and post treatment vadose zone concentrations will enable EPA to evaluate the performance of thermal remediation methods in achieving the expectations discussed in the ROD. MTCA Method B cleanup levels are presented in Table 3.3, Appendix E, of the final thermal design analysis (USACE 2001c).

Compliance with MTCA Method B cleanup levels will be demonstrated by systematic sampling on a sample grid established within the Pilot Test treatment arrays. Samples will be co-located with samples collected during the construction phase of the project. This density of sampling will provide sufficient data to implement the required statistical procedures proscribed under the MTCA Method B cleanup regulations. Samples will then be collected vertically at five-foot intervals beginning at the native soil surface beneath the vapor collection system. As stated in the ROD, compliance must be demonstrated to a depth of 15 feet below ground surface.

Since MTCA requires discrete samples be used to demonstrate compliance, each depth interval will be evaluated separately. As described in MTCA guidance, the distribution of the data from each depth interval will be test with a Wilks-Shapiro Test to determine whether the data set has a normal or logarithmic distribution. The Upper Confidence Limit (UCL) of the mean at each depth interval will be calculated for each of the 15 contaminants that have promulgated MTCA cleanup levels (Table 3.3, Appendix E, of the final thermal design analysis [USACE 2001c]). The calculated UCL will then be compared to the corresponding MTCA Method B cleanup level.

MTCA contains two additional administrative criteria that need to be met before compliance can be demonstrated. The first is that no single compliance sample can be more than twice the cleanup level. Second, compliance with MTCA cleanup criteria is not achieved if more than 10% of the samples exceed the cleanup level.

7.1.15 Process Efficiency and Optimization

Total Steam Production

The steam production from the boiler to the wells will be measured to support the heat flux calculations. The steam will be produced in several chambers in the boiler and piped to a main for distribution to the injection wells. The best location for the flow rate meter will be at the main.

Control of pH at Equalization Tank

The equalization tank (T-401) requires that constant control be maintained over the addition of caustic and coagulants prior to entering the dissolved air flotation tank (DAF). A pH controller that has a meter/dispenser for the caustic can manage additive control. The coagulant influent is usually installed with a flow meter set to a certain flow rate, and the addition of the caustic is the variable that accounts for the fluctuations in contaminant concentration.

Dissolved Oxygen in Extracted Liquid

The dissolved oxygen levels in the extracted well liquid will be measured to indicate the amount of air that should be pumped into the wells to enhance biodegradation and oxidation reactions. These measurements will be made of the liquid influent prior to the treatment plant at the wellheads. If dissolved oxygen levels are low, the air injection rate may be increased to overcome oxygen consumption. Maintenance of dissolved oxygen levels will allow oxidation reactions to proceed in the subsurface along the entire distance between injection and extraction wells.

Temperature and pH of Stream Prior to Bioreactor

The bioreactor is a sensitive process, and in order to establish quality parameters for the reactor, temperature and pH must be monitored before the stream enters the bioreactor. A simple pH/temperature meter that is accessed by analog signal was installed upstream of T-203.

Stream Prior to Bioreactor Analysis

It is important to monitor the amount and variation in contaminants prior to the bioreactor. The bacteria in the bioreactor are sensitive to changes in the influent contaminant concentrations. Monitoring the influent stream and analyzing the temperature, pH, and influent concentration can optimize the bioreactor operation. The stream analysis will include periodic full chemical analysis, but the frequency of that analysis is dependent upon the results of the in-line TOC analysis.

Chemical Oxygen Demand at the Bioreactor

Chemical oxygen demand (COD) is the measure of the amount of oxidizable organic material. COD will be used as an indicator of the efficiency of the bioreactor.

Suspended Solid Testing

The suspended solids effluent from the bioreactor willindicate the performance of the clarification step, which is an important treatment facility parameter. Suspended solids testing will occur downstream of the DAF and the Clarifier (205), to both determine the effectiveness of the DAF and the Clarifier in removing suspended solids as well as to determine how often the media filters may require backwashing due to solids buildup and pressure loss across the filters.

Liquid Treatment System Chemical Concentrations

The liquid treatment stream will be analyzed for PAHs and PCP and TOC at several locations in the treatment plant to monitor removal efficiency. These locations include; after the equalization tank (T-401), after the DAF (tank T-402), after the aeration basin (biological treatmentand media filters and after the CAG units. The frequency of testing will be determined when operational parameters are more completely defined.

7.1.16 Boiler Air Emission

The objective of evaluating and monitoring boiler emissions is to collect the data necessary to demonstrate substantive compliance with local, State and Federal regulations and to demonstrate that the steam boiler portion of the Thermal Remediation Pilot Project will not adversely affect the ambient air quality in the surrounding community. Preliminary calculations have been performed to evaluate the boiler's annual total maximum potential to emit (PTE--boiler running at 100% capacity, full time). Regulatory compliance calculations were based upon manufacturer's emission factors for full-time nominal operations without the non-condensable waste stream running through the system. Further study and analysis will be necessary after the waste stream is introduced into the system.

For combustion emissions without the waste stream, the boiler is expected to be in compliance for all state and federal regulations for emission values, performance standards, and ambient air quality standards (Table 8-5). Emissions testing for the boiler without the waste stream was collected as part of the commissioning process.

The boiler's PTE puts it in the minor source category for the criteria air pollutants (< 100 tons/year for any constituent). However, due to the use of fuel oil the PTE is relatively high for sulfur oxides as compared to natural gas fired boilers of the same capacity.

Although it is possible to estimate the composition and volume of non-condensable vapors entering the boiler, it is difficult to estimate the quantity or variability of the constituents over time. Therefore, it is not possible to conclusively pre-determine the type or amount of hazardous emissions caused by the combustion of the waste stream. The emissions of Toxic Air Pollutants (TAPs) of particular concern (naphthalene, total PAH, PCP and dioxins/furans) shall be determined through stack testing. Testing will occur for a period of time necessary to demonstrate compliance and will coincide with full operation of the steam extraction unit (i.e, non-condensable gases are being fed to the boiler at the estimated maximum rate).

Stack test monitoring will include:

- Dioxins and furans
- Total Hydrocarbons
- Volatile Organics
- Semivolatile Organics
- Polycyclic Aromatic Hydrocarbons
- Hydrogen chloride and chlorine
- Particle Size

Initial estimates of individual contaminant mass flow rates with Washington State Air Toxics De Minimis levels listed in WAC 173-460, indicate the untreated non-condensable vapor stream is predicted to fail the de minimis levels for naphthalene, cycloalkanes and monoaromatics. Naphthalene fails to meet the de minimis value by the greatest percentage. It will require a

99.99% treatment efficiency for the estimated naphthalene emissions to meet the de minimis levels.

7.1.17 Site Fugitive Emissions Monitoring

During thermal operations, two ambient air quality monitoring events will be performed. For each event, air-monitoring instruments will be placed at two locations (to be determined based on the forecasted/current wind direction) surrounding the treatment plant area. One monitor will be placed downwind of the facility and the other will be located upwind of the facility. Analytes measured during operational monitoring of the treatment plant will be PCP and PAHs. Sampling will be performed using a Hi Vol Sampler with XAD-2 resin cartridge or equivalent sorbent (T013A/TO4A). . Two sampling events with an option for one additional event correlated to temperature increases in the Thermal Pilot treatment area will be conducted. The USACE will specify the timing of the events and will provide at least two weeks prior notice to the contractor.

7.1.18 Treatment Plant Discharge Monitoring

Effluent discharge monitoring from the groundwater treatment plant will be modified from the current sampling frequency during the early stages of the pilot study. Initially, effluent will be sampled and analyzed for chemical parameters under the existing permit with the addition of temperature, dissolved oxygen and turbidity. For the first three months of thermal operations, sampling frequency will be:

- Daily effluent sampling during weeks 1 and 2
- Twice weekly sampling for weeks 2 to 3 months
- Biomonitoring at month 3

Based on the results of the sampling data, the sampling frequency will be adjusted as appropriate after the third month of thermal treatment. Any sampling adjustments made will be no less than once per week for effluent chemistry and quarterly for biological monitoring for the remainder of the pilot study.

7.1.19 Waste Disposal Characterization

Sampling will be conducted for some of the waste streams identified below to verify compliance with all applicable State and Federal hazardous waste regulations. The reasons for selective sampling are described in each section below.

Drill Cutting Disposal Characterization

The drill cuttings will be handled on-site and placed in the designated stockpile area until they undergo remediation with the rest of the site soil. The drill cuttings will not require additional sampling.

Well Purge Water Disposal Characterization

Well purge water will be treated at the water treatment plant. By established convention on the site, purge water will be placed in a settling tank to allow suspended solids to settle out. The overlying water will then be pumped or bailed out of the settling tank and fed into the treatment plant. Accumulated solids will periodically be collected and placed in the same soil stockpile as the drill cuttings. No specific sampling or analysis is required unless site conditions change.

NAPL Disposal Characterization

NAPL disposal includes all recovered product from the treatment plant and extraction at the wells. NAPL will be recovered by the treatment plant's on-site recovery system. Disposal follows RCRA for off-site transport and final destruction via incineration due to previously established waste characterization as F032 and F034 listed waste. Recovered product does not need to be sampled due to known high concentrations of contaminants and the designation as a listed waste.

Sludge Disposal Characterization

Sludge consists of spent biomaterials removed from the treatment plant activated sludge bioreactor. Under currently conceived operational scenarios, contaminated groundwater entering the bioreactor will be designated as a listed waste under the contained in rule. However, biological treatment within the bioreactor may eliminate constituents to comply with the Universal Treatment Standards (UTS). Even if monitoring of the bioreactor influent and effluent demonstrates successful treatment to these standards, analysis of the accumulated sludge will be required to determine if the sludge meet the F032 and F034 Land Disposal Restriction treatment standards. Analytes of concern and applicable regulatory thresholds are described in Table 3.5, Appendix E, of the final thermal design analysis (USACE 2001c). Frequency of sampling and analysis will be determined when more is known regarding treatment plant performance and operations under Pilot Study conditions.

Spent Carbon Disposal Characterization

The spent activated carbon (SAC) is subject to sampling to determine the proper disposal method. If sampling of effluent from the bioreactor indicates successful treatment of F032 and F034 listed waste "contained in" groundwater, the SAC may be disposed of in a hazardous material landfill if it meets the RCRA LDR for F032 and F034 waste. However, if groundwater effluent from the bioreactor does not meet UTS the SAC must be incinerated at an approved, permitted unit. Consequently, the waste disposal characterization of SAC is a two-tiered process. The first part of the process is to determine if the SAC should be designated as listed waste by contact with contaminated media (effluent from the bioreactor). Second, the SAC will require testing to determine if concentrations meet the requirement of the LDRs for constituents of the listed waste. Constituents and regulatory thresholds are presented in Table 3.5, Appendix E, of the final thermal design analysis (USACE 2001c). Frequency of sampling will be determined by the rate of contaminant removal from the Pilot Study area and treatment plant efficiency.

Spent Filter Media Disposal Characterization

The spent filter media (the sand filter) is subject to the same testing and criteria as the SAC.

On-Site Analytical Waste Characterization Disposal

Any on-site analytical wastes generated during the Pilot Study operations will be lab packed for and disposal in accordance to State and Federal regulations. At this time, specific requirements cannot be determined until the full extent of on-site analytical activity is known.

7.1.20 Site Perimeter Environmental Monitoring

The objective of site perimeter monitoring is to evaluate potential impacts of Pilot Study operations on the surrounding community and to demonstrate substantive compliance with local, State and Federal environmental regulations. In addition, data collected during the Pilot Study will be used to infer possible impact during full-scale treatment if EPA selects the thermal remedy. Perimeter monitoring is focused on measuring and evaluating impacts beyond the perimeter of the site.

Noise Monitoring

The substantive requirements related to the impact of the operations on the Wyckoff site on nearby residential areas is described in the Washington Administrative Code (WAC 173-60, Maximum Environmental Noise Levels). The objective of noise level monitoring is to evaluate the impact on the surrounding community during all operational phases of the Pilot Study. Since most of the surrounding area is residential, the Class A receiving noise level of 55 dBA is the regulatory threshold for Pilot Study operations between the hours of 7:00 am to 10:00 pm. During all other times, noise levels at receiving properties cannot exceed 45 dBA.

Prior to actual Pilot Study operations, a background study was conducted to measure ambient noise conditions at the four community monitoring locations. The four monitoring locations were; 1) the Wing Point residential area; 2) the Washington State Ferry Terminal; 3) the marina directly west of the former Wyckoff facility; and 4) the residential area directly south of the former Wyckoff facility. Up to four monitoring events may be conducted during the six months of planned steam injection activity at the site.

Background and monitoring events will utilize Type I or Type II sound level meters with demonstrated accuracy of ± 1 dBA for Type I meters and ± 2 dBA for Type II meters. At the time of testing, wind speed will not exceed 12 mph and no testing will occur when precipitation is falling at a rate that will affect measurement readings. During the test, the microphone used must be oriented in the direction of the Wyckoff facility.

Intertidal Area Thermal Effects Study (TES)

Possible effects of full-scale thermal remediation are of concern in intertidal and shallow subtidal areas in Eagle Harbor and Puget Sound. The intertidal habitat surrounding the Wyckoff site is considered a sensitive area and the potential heat and disturbance impacts to water and sediments require monitoring. Potential impacts may include migration of heat effects beyond control measures (water or sediment temperature may increase some distance from the sheet pile wall), and mobilization of existing NAPL outside of the sheet pile wall. All of these impacts have a reasonable probability of being adequately addressed by control measures. However, Natural Resource Trustees (NRT's) have requested that a study be initiated to determine changes in physical and biological processes in the intertidal area and especially to eelgrass due to upland thermal remediation. The TES will be performed by Seattle District employees to provide quantitative biological and physical data for deciding whether or not upland remedial activities will impact the intertidal area. Baseline sampling began in April 2000 and was completed in June 2000 to document existing biological conditions in the intertidal area adjacent to the Wyckoff facility and at a reference area in Eagle Harbor.

Thermal monitoring will be conducted outside the perimeter of the Pilot Study area at three locations to evaluate the extent of heating beyond the perimeter of the Pilot Study area. These empirical results will be used to calibrate the 2-D Shoreline Model (USACE 2000b) to confirm the expected conduction of heat beyond the active treatment area. If heating outside the active treatment zone is greater than predicted by the existing model, the Thermal Effects Study Management Plan (USACE 1999) will be implemented to conduct a more compete evaluation of conditions in the intertidal area during full scale thermal remediation.

Lower Aquifer Monitoring

Monitoring of the lower aquifer will be conducted to address concerns that heating of the upper aquifer may result in mobilization and downward migration of NAPL into the lower aquifer. Lower aquifer contaminant monitoring will be conducted prior to steam injection to obtain baseline data. Subsequent sampling will occur monthly for the first three months of steam injection then quarterly until the treatment area cools to ambient temperature. The frequency of sampling was determined with the concurrence of the Washington State Department of Ecology and the local community. Lower aquifer wells on site along with nearby public water supply wells will be sampled. Parameters of interest and required sensitivity are summarized in Table 3.2, Appendix E, of the final thermal design analysis (USACE 2001c).

7.1.21 Sheet Pile Wall Performance Monitoring

Structural Monitoring of the Sheet Pile Barrier

The sheet pile wall may structurally deform or expand as a result of the high site temperatures. Nine settlement monitoring points will be established on the top of the sheet pile wall adjacent to injection wells. A settlement survey will be conducted on a semiannual schedule during the pilot test.

Sheet Pile Leakage Monitoring

Monitoring leakage through the unwelded joints in the sheet pile wall will consist of measuring water levels, conducting pumping tests and determining if NAPL is present in the specially installed joint observation wells welded to joints at various locations along the sheet pile wall. The objective of the sheet pile wall leakage monitoring is to determine if interlocking joints of the containment wall inhibit the flow of NAPL and contaminated groundwater from the Wyckoff facility towards Eagle Harbor and Puget Sound.

The primary method for evaluating leakage will be by conducting modified pump tests on each of the joint observation wells installed on the sheet pile wall. These tests will consist of measuring the initial water and/or NAPL levels with an interface probe. A pump will then be inserted into the observation well and set to a reasonable pumping rate to obtain a 1-5 foot draw down within the observation well. The pump rate and draw down will be recorded each minute until both readings stabilize for 10 minutes. The recorded pump rate and head differential will then be used to calculate near-steady-state specific capacity for each of the observation wells. The specific capacity can be used to estimate interlock leakage rates for different water-level conditions. If NAPL or substantial groundwater leakage appears to be occurring, water quality monitoring may be conducted to determine the direction of water flow (into or out of the site). Direction of flow will be inferred by an increased occurrence of oxidation daughter product from within the Pilot Study area. For example, NAPL or contaminated groundwater leaking from within the Pilot Study cell will likely contain a greater concentration of naphthanols and quinones than contaminated media leaking into the observation well from outside the active treatment area. A total of three joint observation wells will need to be monitored within three months of sheet pile wall installation and after active steam injection.

7.1.22 Corrosion Monitoring

Subsurface conditions expected during both the Pilot Study and full-scale thermal treatments are anticipated to create a highly corrosive environment that may substantially affect the integrity of the sheet pile wall. High temperatures and the injection of air into the subsurface may substantially increase corrosion of the containment wall resulting in reduced service life. To address this issue, soil samples will be collected in October 2000 and used to determine site specific corrosion rate at temperatures expected to occur during both the Pilot Study and full-scale thermal remediation. Evaluation of this data will allow more precise estimates of the containment wall's design life and provide information on the extent of corrosion protection that will be required to maintain the wall's integrity.

In the event that corrosion protection is required and constructed, monitoring can be initiated to confirm that the wall is adequately protected. A simple copper/ copper sulfate cell can be constructed by placing a segment of copper in a vial containing a sulfate solution with a permeable membrane at the bottom. The permeable membrane end of the cell is placed in contact with site soils and the copper contact is attached to the sheet pile wall. If the voltage across the copper contact (between the sulfate cell and the sheet pile wall) is greater than –0.85 volts, then the wall is not protected from corrosion. Consequently, the performance of any constructed corrosion protection can be evaluated prior to substantial loss of wall thickness.

Table 7-1
Project Objectives Worksheet

Project Objective					Data Users	Project Objective Classification
Number	Executable Stage: Current	Executable Stage: Future	Description	Source		
1	C	A	Prevent human exposure through direct contact (ingestion, inhalation or dermal contact) with contaminated soil.	ROD	X Risk X Compliance X Remedy X Responsibility	Basic X Optimum Excessive
2	A, B		Reduce NAPL source and the quantity of NAPL leaving the upper aquifer beneath the Former Process Area sufficiently to protect marine water quality, surface water and sediments. Site specific groundwater contaminant concentrations will be met at the mud	ROD	X Risk X Compliance X Remedy X Responsibility	X Basic Optimum Excessive
3		A, B	Ensure contaminant concentrations in the upper aquifer leaving the Former Process Area will not adversely affect marine water quality and aquatic life in surface water and sediment.	ROD	X Risk X Compliance X Remedy X Responsibility	Basic X Optimum Excessive
4		A	Protect the groundwater outside the Former Process Area and in the lower aquifers, which are potential drinking water sources.	ROD	X Risk X Compliance X Remedy X Responsibility	Basic X Optimum Excessive
5		A	Protect humans from exposure to groundwater containing contaminant concentrations above MCLs.	ROD	X Risk X Compliance X Remedy X Responsibility	Basic X Optimum Excessive
6		A, B, C	Prevent storm water runoff containing contaminated soil from reaching Eagle Harbor	ROD	X Risk X Compliance X Remedy X Responsibility	Basic X Optimum Excessive

Notes:
A - Thermal Pilot Study
B - Sheet Pile Wall
C - Soil Removal

Table 7-2
Performance Project Objectives Worksheet

Project Objective						
	Executable Stage					
Number	Current	Future	Description	Source	Data Users	Project Objective Classification
1	X		Demonstrate that thermal remediation technologies will remove substantially all mobile NAPL from the Pilot Study treatment area.	ROD	X Risk X Compliance X Remedy X Responsibility	Basic X Optimum Excessive
2	X		Demonstrate that post-thermal treatment concentrations of NAPL constituents dissolved in groundwater that move from the site to Eagle Harbor and Puget Sound will not exceed marine water quality criteria, surface water quality and sediment standards at the mudline. The demonstration will use predictive modeling based on the results of the Pilot Study, laboratory studies and field measurements.	ROD	X Risk X Compliance X Remedy X Responsibility	Basic X Optimum Excessive
3	X		Demonstrate that surface soil (0 to 15 feet bgs) concentrations within the Pilot Study area attain MTCA Method B cleanup levels.	ROD	X Risk X Compliance X Remedy X Responsibility	Basic X Optimum Excessive
4	X		Determine the potential impacts (noise, air emissions and odors) of full-scale thermal treatment to the surrounding community.	ROD	X Risk X Compliance X Remedy X Responsibility	Basic Optimum X Excessive
5	X		Evaluate the possible adverse effects that full-scale thermal treatment may have to Eagle Harbor and Puget Sound near-shore marine habitats.	ROD	X Risk X Compliance X Remedy X Responsibility	Basic Optimum X Excessive
6	X		Evaluate operational approaches to thermal remediation, which may impact the removal of NAPL such as steam movement and recovery of NAPL from the aquitard surface.	ROD	X Risk X Compliance X Remedy X Responsibility	Basic X Optimum Excessive

Table 8-2 (Continued)
Performance Project Objectives Worksheet

Project Objective					Data Users	Project Objective Classification
Number	Executable Stage: Current	Executable Stage: Future	Description	Source		
7	X		Evaluate treatment plant performance during the Pilot Study to allow optimization of operations and monitor mass balance of contaminant removal.			Basic X Optimum Excessive
8	X		Evaluate microbial populations and contaminant oxidation before, during and after thermal treatment to assist in the determining mass balance of contaminant destruction.			Basic X Optimum Excessive

Table 7-3
Data Users and Data Classification

Risk Perspective
Develop remedial action objectives and clean-up levels. Perform detailed analyses of risk reduction and fate and transport. Evaluate suitability of site controls for short-term risks associated with remediation. Verify safety of working conditions for personnel during treatment, construction and O&M.
Compliance Perspective
Determine a site's substantive regulatory compliance with each ARAR. Properly manage remediation and investigation derived waste. Contribute to development of RAOs and their compliance with ARARs. Complete procedural requirements under the law governing the response action (CERCLA). Predict legal or regulatory issues that will drive response or other regulatory actions. Comply with specific sampling requirements of federal and state programs.
Remedy Perspective
Determine of chemical and physical characteristics of the site to evaluate remedy performance. Prepare engineering design and construction plans. Optimize operation and maintenance activities and long-term monitoring. Gather cost and performance data needed for life-cycle assessments, evaluation of technology on similar sites, incorporation of lessons learned and future design improvements.
Responsibility Perspective
Define federal or non-federal entity has responsibility for a site's condition. Determine federal liability at a site and deal with legal issues.
Data Implementers
Technical personnel responsible for identifying sampling and analysis methods suitable data user's needs.

Table 7-4
MFR Worksheet for TPP Team

Decision Makers		Data User Perspectives		Data Implementer Perspectives	
Customer:	MaryJane Nearman, EPA Region 10 RPM	**Risk:**	Travis Shaw Mike Bailey	**Sampling :**	Travis Shaw Mike Bailey Steve Meyerholtz Brenda Bachman
Project Manager:	Kathy LeProwse, USACE, Seattle District	**Compliance:**	Travis Shaw, Brenda Bachman, Kim Calhoun		
Regulators:	Chung Yee, WA State Dept. of Ecology	**Remedy:**	Travis Shaw Mike Bailey Brenda Bachman Marlowe Dawag Consultants EPA Mgt.	**Analysis:**	Travis Shaw Mike Bailey Brenda Bachman Marlowe Dawag Consultants
Stakeholders:	Environmental Trust	**Responsibility:**	Kathy LeProwse MaryJane Nearman Office of Counsel		
	City of Bainbridge Island				
	Natural Resource Trustees				
Customer Goals: Assess the likelihood that a full scale thermal remediation will achieve the cleanup goals for the site. Provide information for implementation of full-scale thermal remediation.					

Table 7-5
Estimated Primary Ambient Air Quality Parameter Emissions

Constituent	Potential to Emit[1] (pounds/hour)	Estimated Annual Emissions (tons/year)
CO	2.34	10.28
NOx	5.90	25.85
SOx	17.43	76.36
VOC	1.00	4.41
PM	0.83	3.67

[1]Based on the manufacturer's emission factors

8.0 DATA MANAGEMENT PLAN

Project data management will utilize a number of different systems for collection, management and reporting of various types of project data. These data are generally divided into Project Management Data and System Operational Data. Project Management Data includes budget and cost data, and project plans, reports, and other deliverables. System Operational Data includes inventories, preventive maintenance schedules and completions, corrective maintenance records, process and compliance monitoring data (including analytical data), operating logs, and chemical quality control data and reports. The data management systems vary with the type and nature of the data being managed. These data management systems are described in this Plan.

8.1 PROJECT MANAGEMENT DATA

8.1.1 Budget and Cost Data

The budget for this project has been established through our contract with the USACE. Most of this budget is based on Lump Sum Fixed Price costs. SCS tracks actual cost against our budgets using the Deltek Advantage computerized financial management system which will track both labor and other direct costs for individual Task Orders and Modifications under this contract.

Corrective and minor maintenance material and labor costs will be tracked separately using both Deltek Advantage reports and an Excel spreadsheet to reconcile monthly costs for corrective and minor maintenance against the maintenance and repair cost limitations specified in Section H2 of the SCS Contract Specifications. If costs for corrective and minor maintenance look like they will exceed the costs limits set in the contract, we will notify the COR before incurring additional maintenance and repair expenses during the month.

Similar procedures will be used to track costs for work performed under Work Authorization Directives (WADs).

Once a month, a summary report of costs expended in the previous month and costs to date broken down by Contract Line Item will be prepared and submitted along with our invoice for services.

8.1.2 Plans, Reports, and Deliverables

Paper and electronic files of all plans, reports and other deliverables will be maintained by SCS Engineers in the Bellevue Office. A copy of all plans, procedures and other documents pertaining to the operation and maintenance of the facility will be kept on file at the SCS/OMI project site office as well.

8.2 SYSTEM OPERATIONAL DATA

8.2.1 Property and Material Inventories

An inventory of Government owned equipment will be maintained in the Maintenance Pro data system. Repairs and/or replacement of this equipment and acquisition of new equipment will be recorded in Maintenance Pro to keep the status of all government owned equipment up-to-date.

An inventory of expendable materials and supplies will also be tracked in the Maintenance Pro system. At the beginning of the contract, the quantities of expendable materials and supplies in the inventory will be developed. Routine inspections and/or preventive maintenance activities will update the use of the expendable materials and supplies and keep track of the quantities on-hand. This information will be used to identify need to reorder materials and replenish supplies.

8.2.2 Maintenance and Repair Activities

Routine preventive maintenance and operation activities will be identified from the equipment O&M manuals and past experience for entry into the Maintenance Pro maintenance management system. Routine maintenance and repair activities will be scheduled and tracked using the Maintenance Pro system. Corrective maintenance activities will also be logged in the Maintenance Pro system for tracking and maintenance history documentation.

Daily Round Sheets will be used as a checklist for daily inspections. Completion of routine, corrective, and preventive maintenance activities will be recorded in the Maintenance Pro system. Weekly synopsis reports will summarize operation and maintenance activities for the previous week.

Originals of the Daily Round Sheets and weekly reports will be kept on file in the on-site field office. Weekly reports will be distributed to the Corps of Engineers representative.

8.2.3 Process Monitoring Data

Collecting, managing and reporting of the Pilot Remediation Process Monitoring data is critical to successful operation of the pilot remediation system. Pilot process monitoring data is divided into the following major categories:

- General Operational Data
- Pilot Area Surface Temperature, Pressure, and Flow Data
- Subsurface Temperature, Pressure, and Flow Data
- Contaminant Removal and Recovery Data
- Boiler Plant Operations Data

- Treatment Plant Operations Data
- Community and Environmental Impacts Data

General Operations

During pilot operations, Daily Operational Data will be recorded in the Daily Operations Log Book. The Daily Operations Log will include notations and summary of all activities at the site. Boiler Plant and Treatment Plant Operations Log books will also be kept by the Boiler and Treatment Plant Operators respectively. A Site Control Log will also be kept at the entry to the site to record the entry and exit of all persons on the site. This log will be collected at the end of each day and filed in the on-site field office. Copies of the visitor logs will be submitted with the weekly report.

Pilot Area Injection and Extraction System Data

During operation of the steam injection and extraction systems, a daily pilot operations log of the pilot area injection and extraction system will be completed. This log will record operational conditions and hours of operation for each of the steam injection, extraction, and vapor recovery wells, and the overall steam injection rate. Operational data will include temperature, pressure and flow measurements from a combination of manually-read gauges, electronic data recording instruments, and calculations based on other data. All manually-read instrument data will be recorded on the daily log sheets and entered into an SQL relational database the same day. Operational data from the daily logs will also be entered into the SQL database. Copies of the daily logs will be kept on-file for verification purposes and will be submitted with the weekly report.

Manually-read instruments include:

- Two steam pressure gauges on either side of the control valve for each of the 16 injection wells (Total of 32 gauges). These gauges will be read in PSIG units every day that the steam injection is operational. This data will be used to record steam pressure at each well head and calculate the steam flow rate and total mass of steam injected over time.
- Two combination pressure gauges on either side of the control valve for each of the extraction wells (except E-4) (six wells) and 8 vapor collectors (total of 28 gauges). These gauges will be read every day that the extraction system is operational. This data will be used to record vapor pressure or vacuum at each well head and vapor collector and to calculate flow in the vapor extraction system at each extraction point.

- One temperature gauge on the liquid extraction line of each of the seven extraction wells (total of seven gauges). These gauges will be read every day that the extraction system is operational.
- Control valve position will be used in conjunction with pressure data to calculate flow for both the steam injection and vapor extraction systems. Valve position will be recorded on each of the 16 steam injection wells, 7 extraction wells, and 8 vapor collectors (Total of 31 valve positions).
- Two vapor flow meters will be used to keep track of vapor flow rates at the connection of the vapor cap collection system and the conveyance system at well E-4 and in the vapor main.

Subsurface Temperature, Pressure, and Flow Data Collection and Management

Table 8-1 lists the instrumentation that will be monitored electronically. Data readings from this instrumentation will be uploaded to the USACE electronic data collection systems.

Table 8-1
Electronically Monitored Instrumentation in Pilot Area

Instrumentation	Parameters Monitored	Location
611 Thermal Sensors	Temperature	Multiple depths at each of 16 injection wells and 65 instrument strings throughout and outside of the pilot area.
62 Thermal Sensors	Temperature	Vapor collection layer at each of 7 extraction wells and 65 instrument strings.
15 Pressure Transducers	Air/water pressure to establish groundwater levels	Bottom of eight instrument strings and seven extraction wells.
7 Pump Stroke Counters	Pump stroke count to determine flow rate	Each of 7 liquid extraction wells.
1 TOC Analyzer	Total Organic Carbon in liquid effluent from pilot area	Junction of well field liquid influent and condensed vapor stream.
3 Vapor Flow meters	Vapor flow rate	Well E-4 Vapor extraction line, Connection of vapor cap collection system and the conveyance system at well E-4, and the vapor

		main.

Two USACE operated and maintained electronic data collection systems will be used to collect and process data from the field instruments. Details of this data collection system are provided in the Field Sampling Plan (Appendix A).

Data from the instrumentation system will be collected daily via modem by Seattle District and on-site contractor staff. Data will subsequently be plotted using off-the-shelf graphics and data visualization software and posted to a web site for review. Temperature, flow and pressure data from the SQL database will also be entered into dedicated spreadsheets for use in reporting total enthalpy and other operational parameters for use by the operations team.

Extracted liquid samples collected at each extraction well sampling port will be used to delineate the composition of the contaminants recovered from the Pilot Study Area during thermal operations. Up to 14 samples will be collected each day and visually examined for NAPL content. Dissolved oxygen and CO_2 levels will be measured in the field as described in the Field Sampling Plan (Appendix A). Record of samples collected, visual descriptions, and field analysis results will be recorded on an Extraction Well Field Sampling Log. Sampling information will be entered into the SQL database. Representative samples will be shipped to the project CLP laboratory for analysis of PAHs and PCP. Lab data will be provided in hard copy and electronically from the Laboratory. Electronic data will be imported into the SQL database for reporting and analysis purposes. Hard copies of the data will be filed at the site field office. Copies of the sampling forms and lab data will be provided in the weekly report.

Boiler Plant

A Daily Boiler Operations Log will be kept by the Boiler Operators to record boiler operational data. Operational data will include identification of the operator(s) in attendance, hours of operation, the boiler fuel level in the main fuel tank, and operating conditions (flow, discharge, pressure, temperature records). Other operations data including maintenance activities performed, problems encountered, shutdowns, unusual operations, optimization procedures and any specific operations data required by the O&M manuals will also be recorded in the Daily Boiler Operations Log.

Non-condensable gas stream samples will be collected and analyzed on a weekly basis during and after the active steam injection period while the vapor extraction system is operational. A record of samples collected will be recorded on a Field Sampling Log form. Lab data will be provided in hard copy and electronically from the Laboratory. Electronic data will be imported into the SQL database for reporting and analysis purposes. Hard copies of the data will be filed at the site field office. Copies of the sampling forms and lab data will be provided in the weekly report.

Table 8-2 lists boiler and vapor treatment instrumentation to be monitored in the boiler building. Data will be recorded in the Boiler Plant Operations Log. Data used for pilot process control will be entered into the SQL database for processing and reporting.

Table 8-2
Boiler and Vapor Treatment Instrumentation

Instrumentation	Parameters Monitored	Location
Temperature gauges	Temperature of liquid effluent and cooling water	Downstream of each liquid heat exchanger.
Temperature gauges	Temperature of vapor and liquid condensate	Downstream of each vapor condenser.
Insertion Gas Mass Flow Meter	Non-condensable vapor flow rate	Downstream of vapor condenser (upstream of non-condensable vapor treatment system – boiler or thermox unit)
Pressure Gauge	Vapor Pressure	Inlet of vapor treatment unit (boiler or thermox unit)

Process, emission gas and particulate matter samples from the boiler and treatment plant used to demonstrate substantive compliance with Federal, state and local air quality regulations shall be collected and analyzed by an air monitoring contractor under a separate contract. Reports and data from these sampling activities will be filed at the site field office. Copies of these reports and data will be included in the weekly report.

Groundwater Treatment Plant

Data collected from the groundwater treatment plant will be used for process monitoring and control as well as for effluent discharge compliance.

Treatment Plant Process Monitoring and Control Data

Treatment Plant Process Monitoring data will include field instrument readings, sampling records and results from field or on-site laboratory analysis, and daily operational logs. Daily operational logs and preventive maintenance inspections are describe above in Section 1.2.2 – Maintenance and Repair Activities.

Field instrumentation and measurements are shown in Table 8-3. These data will be recorded on the Treatment Plant Operations Log forms and transferred to Excel spreadsheets or the SQL database for processing and reporting. The daily logs will be kept on file in the site field office with a summary included in the weekly report.

Treatment Plant process monitoring samples will be collected for on-site and off-site lab analysis as indicated in the Field Sampling Plan (Appendix A). Information about samples collected will be recorded on the Treatment Plant Sampling Log and, where appropriate, the Chain of Custody form. Sampling information will be entered into Excel spreadsheets or the SQL database. On-site lab data will be recorded on lab analysis forms and recorded in the Excel spreadsheet or SQL database. Off-site lab data will be recorded into the Excel spreadsheets or imported into the SQL database for reporting and analysis purposes. Hard copies of all lab data will be filed at the site field office. Copies of the sampling forms and lab data will be provided in the weekly report.

Table 8-3
Treatment Plant Field Instrumentation and Measurements

Instrumentation	Parameters Monitored	Location
pH Controller	pH	Caustic and Acid Mixer/Injection
Water Level/Interface probe	Water and product levels	Tanks T401, T-105, T-402
pH Controller	pH	Middle of tank T-402
Thermocouple	Temperature	Outlet of T-402, T-303
Flow meter	Liquid flow rate	Outlet of T-402
Pressure gauges	Water pressure	Multimedia filter inlet & outlet, GAC vessels

Discharge Compliance Monitoring Data
Samples of the treatment plant effluent will be collected for chemical analysis once per week and once per quarter for biological compliance monitoring in accordance to procedures described in the Field Sampling Plan (Appendix A). Information about samples collected will be recorded on the Treatment Plant Sampling Log and, where appropriate, the Chain of Custody form. Effluent temperature and flow data will be recorded in the Daily Treatment Plant Operations Log. On-site lab analysis data for pH and dissolved oxygen will be record on lab data forms and transferred to Excel spreadsheets or the SQL database. Lab data will be provided in hard copy and electronically from the Laboratory. Electronic data will be imported into Excel spreadsheets or the SQL database for reporting and analysis purposes. Hard copies of the data will be filed at the site field office. Copies of the sampling forms and lab data will be provided in the weekly report.

Community and Environmental Impacts Data

Community and Environmental Impacts data includes:

- Upper and lower aquifer groundwater monitoring data
- Noise Data
- Air Quality Data
- Weather Data

- Intertidal Area Thermal Effects Study (TES) Data
- Sheet Pile Wall Performance Monitoring Data

Groundwater Monitoring Data
Upper and lower aquifer groundwater samples will be collected for field and laboratory analysis in accordance with the schedule and procedures described in the Field Sampling Plan. Information about samples collected and field measurements will be recorded on the Groundwater Field Sampling Logs and/or Chain of Custody forms. Lab data will be provided in hard copy and electronically from the Laboratory. Electronic data will be imported into Excel spreadsheets or the SQL database for reporting and analysis purposes. Hard copies of the data will be filed at the site field office. Copies of the sampling forms and lab data will be provided in the weekly report.

Noise Data
Noise monitoring will be conducted to evaluate impacts of the pilot plant operations on the surrounding community. Noise measurements will be collected using recording instruments in accordance with procedures specified in the Field Sampling Plan (Appendix A). Data will be downloaded from the field instruments and reported in a Noise Monitoring report. Copies of the noise monitoring reports will be kept at the onsite field office and submitted with the weekly report.

Air Quality
Site perimeter and on-site air quality will be monitored for compliance with ambient air quality standards and to evaluate worker exposure related to health and safety protection.

Perimeter and On-Site Air Monitoring Samples
Perimeter air monitoring samples will be collected and analyzed by an air monitoring contractor under a separate contract. Copies of the perimeter air monitoring reports and data will be kept at the onsite field office and included in the weekly report.

Health and Safety Air Monitoring
Health and Safety breathing zone air quality monitoring will be conducted to evaluate levels of protection necessary for workers exposed to airborne contaminants. Breathing zone monitoring will be conducted in accordance with procedures specified in the Field Sampling Plan. Sample collection will be documented on Field Sampling Logs and Chain of Custody forms. Samples will be submitted for analysis to offsite analytical labs. Data from the labs will be summarized in a letter report. Copies of the report and lab data will be kept on file at the onsite field office and submitted with the appropriate weekly report.

Weather Data
Weather monitoring data will be recorded at about the same time each day from the Field Weather Station terminal in accordance with procedures specified in the Field Sampling Plan

(Appendix A). Data will include temperature, previous 24 hour high and low temperature, wind speed, wind direction, barometric pressure, and, 24 hour precipitation. Data will be recorded on the Daily Pilot Area Log and entered into the SQL database for reporting and analysis. Meterological data for the previous 24 hours will be include in the Daily Operations Report.

Intertidal Area Thermal Effects Study (TES) Data

The purpose of the TES is to identify and monitor the impacts of full-scale thermal remediation in the intertidal area surrounding the Wyckoff facility. Monitoring will determine acute and chronic thermal affects on the most sensitive biotic attributes of the intertidal area and determine if changes in physical processes (i.e. sediment transport) affect or act synergystically with thermal effects to impact biota. The USACE will be responsible for collecting and reporting all TES information.

Sheet Pile Wall Performance Monitoring Data

The ability of the sheet pile wall to minimize movement of contaminants between the soils receiving steam injection and the adjacent area is measured in joint observation wells located at three locations on the pilot area wall. The joint observation well tests provide effective hydraulic conductivity values for sheet pile walls to be simulated in the site groundwater model and the pilot test multiphase-thermal model. The USACE will be responsible for collecting and reporting all sheet pile performance monitoring data.

Waste Disposal Data

All records of hazardous waste transportation, storage, treatment, and disposal will be filed at the onsite field office and handled in accordance with the project Waste Management Plan (REFERENCE?). A summary of waste handling and disposal activities will be included in weekly reports. Wastes requiring lab analysis prior to disposal will be sampled in accordance with procedures specified in the Field Sampling Plan (Appendix A). Information about samples collected will be recorded on Field Sampling Logs and Chain of Custody forms. Lab results will be provided in hard copy and electronically from the Laboratory. Electronic data will be imported into Excel spreadsheets or the SQL database for reporting and analysis purposes. Hard copies of the data will be filed at the site field office. Copies of the sampling forms and lab data will be provided in the weekly report.

8.2.4 DATA Reporting/OUTPUT

Data reporting will include daily, weekly, monthly and final reports. A project data web site will be maintained and updated by the USACE where pilot monitoring and operations data and charts will be posted for review and use by the operations team.

8.2.4.2 Daily Operations Report/Graphs/Charts

A daily operations report will be prepared with updated tables, graphs and charts showing the progress of pilot remediation processes over time. The daily operations report will include:

- Hours of operation for the boiler plant, injection wells, extraction wells, and treatment plant
- Hours of downtime the boiler plant, injection wells, extraction wells, and treatment plant
- Cumulative Hours of Operation
- Meteorological Data
- Process Stream and Equipment Monitoring Data
  - ☐ For each Injection Well (sixteen wells total) plots of:
    - ✓ Rate and mass of steam injected versus time
    - ✓ Cumulative rate and mass of steam versus time
  - ☐ For each Extraction well (seven wells total) plots of:
    - ✓ Liquid flow rate vs. time
    - ✓ Vapor flow rate vs. time
    - ✓ Average Temp at each well head
    - ✓ Dissolved Oxygen of extracted liquid
    - ✓ TOC of extracted liquid
    - ✓ Pumping rates for each well
  - ☐ Remediation System as a whole, plots of:
    - ✓ Concentration of contaminants recovered over time
    - ✓ Mass removal rate of contaminants over time
    - ✓ Cumulative mass of contaminants removed over time
    - ✓ Water levels within the treatment area
    - ✓ Enthalpy fluxes versus time
    - ✓ Cumulative energy balance
    - ✓ Cumulative water balance
    - ✓ Volume of NAPL recovered

All time plots shall show a two month window with the window sliding one month at a time at the end of each month.

8.2.4.3 Weekly Chemistry Data Package; FIO.

The weekly chemistry data package will be provided to the operations team every 7 days of the project and as an attachment to the Chemical Data Final Report. All chemical data packages shall be submitted as paper hard-copies and in an electronic format. Electronic data packages will be posted on the project data web site.

Weekly Summary Reports shall include: all of the daily reports/graphs; boiler fuel level; vacuum and flow in vapor control system, and; air monitoring results compared to compliance levels. Air monitoring results will be provided under separate contract and provided as an attachment to the weekly report. The Weekly Summary will also include a summary of boiler, pilot area, and treatment plant operations and maintenance activities for the previous week.

8.2.4.4 Monthly Chemistry Data Package

A monthly chemistry data package will be prepared and submitted once per month. The report will include a summary of analytical results obtained by the Contractor during the previous 30 days, a summary of analytical results provided to the Contractor by the Government Laboratory during the previous 30 days, results and comparison of PE analysis conducted during the previous 30 days, and a data quality assessment report for all data collected during the previous 30 days. In addition the monthly chemistry data package will include the following:

a. Summary of any deviations from the design chemical parameter measurement specifications.
b. Summary of chemical parameter measurements performed as contingent measurements.
c. Summary discussion of resulting data including achieving data reporting requirements.
d. Summary of achieving project specific DQO.
e. Presentation and evaluation of the data to include an overall assessment on the quality of the data for each method and matrix.
f. Internal QC data generated during the project, including tabular summaries correlating sample identifiers with all blank, matrix spikes, surrogates, duplicates, laboratory control samples, and batch identifiers.
g. A list of the affected sample results for each analyte (indexed by method and matrix) including the appropriate data qualifier flag (J, B, R, etc.), where sample results are negatively impacted by adverse quality control criteria.
h. Summary of field and laboratory oversight activities, providing a discussion of the reliability of the data, QC problems encountered, and a summary of the evaluation of data quality for each analysis and matrix as indicated by the laboratory QC data and any other relevant findings.

8.2.4.5 Chemical Data Final Report (CDFR)

The Chemical Data Final Report will include a summary of quality control practices employed and all chemical parameter measurement activities. The CDFR will contain the following:

a. Summary of project scope and description.
b. Summary of any deviations from the design chemical parameter measurement specifications.
c. Summary of chemical parameter measurements performed as contingent measurements.
d. Summary discussion of resulting data including achieving data reporting requirements.
e. Summary of achieving project specific DQO.
f. Presentation and evaluation of the data to include an overall assessment on the quality of the data for each method and matrix.

g. Internal QC data generated during the project, including tabular summaries correlating sample identifiers with all blank, matrix spikes, surrogates, duplicates, laboratory control samples, and batch identifiers.
h. A list of the affected sample results for each analyte (indexed by method and matrix) including the appropriate data qualifier flag (J, B, R, etc.), where sample results are negatively impacted by adverse quality control criteria.
i. Summary of field and laboratory oversight activities, providing a discussion of the reliability of the data, QC problems encountered, and a summary of the evaluation of data quality for each analysis and matrix as indicated by the laboratory QC data and any other relevant findings.
j. Conclusions and recommendations.
k. Appendices containing (1) Chemistry data package, and (2) Results and comparison of PE analysis.

9.0 CONTRACTOR QUALITY CONTROL PLAN

9.1 PURPOSE

This document presents the Contractor's Quality Control Plan (CQCP) for work activities that will be conducted during the remediation activities at the Wyckoff Operable Unit (OU) on Bainbridge Island, Washington. This CQCP has been developed in accordance with Section 01451, "Contractor Quality Control" and Section 01330, "Submittals," to maintain an effective quality control system. The quality control system consists of plans, procedures, and organization necessary to ensure that the project is performed according to the project specifications and within schedule. This CQCP covers all operation and maintenance activities with consideration and incorporation of the contract objectives and the proposed remediation sequences.

The elements of this plan, as approved by the contracting officer (CO), will apply to all persons conducting business at this site under Contract No. DACA67-01-D-1007 Task Order 0003. These persons shall include employees of SCS Engineers, its subcontractors and vendors.

9.2 POLICY

SCS Engineers, through the utilization of a quality control system, strives to obtain a uniform, high quality level of workmanship throughout all phases of mobilization, remediation, and operation and maintenance activities. In order to help accomplish this goal, the following principles will be observed:

- Assure the highest quality by maintaining supervised controls and written instructions governing quality control procedures and practices, and establishing clearly defined responsibilities and authority to enforce compliance.
- Conform to all contractual requirements, specifications, and the CQCP. Compile accurate records of required documentation.
- Notify project management and the government of quality discrepancies for immediate corrective action. Ensure that corrective action is implemented properly.

9.3 ORGANIZATION

SCS Engineers will serve as the prime contractor on this project and will provide overall project implementation, supervision, project coordination, contractor quality control (including any subcontractor and vendor), contract compliance monitoring, operation and maintenance, and remediation services. Both SCS Engineers and our primary subcontractor, OMI will be responsible for contractor quality control functions, site health and safety, performing remediation, operation and maintenance services, and limited collection and validation of analytical samples. Sample analysis will be provided by both U.S. EPA government labs and Severn Trent Laboratories (STL).

SCS Engineers will ultimately be responsible for resolving project quality control issues. However, its subcontractors (particularly OMI) will play a significant role in the overall project quality control (CQC) program as well as the U.S. Army Corps of Engineers (USACE). In general, the CQCP is intended as an informal partnering of SCS Engineers and the USACE to ensure on-time completion of the project in accordance with the contract specifications. A table showing the lines of authority and organization is provided in Figure 9-1.

9.3.1 CQC System Manager

Mr. David Roberson of SCS Engineers will be the CQC system manager for this project. Mr. Roberson will be responsible for overall management of contractor quality control. A copy of the CQC system manager's resume is presented in Appendix B. Mr. Cliff Leeper of OMI will be the CQC Site Supervisor. As the Site Supervisor, Mr. Leeper will be on-site during normal operating hours. Mr. Joe Harrington of SCS Engineers will serve as the alternate CQC System Manager in the absence of Mr. Roberson.

The CQC System Manager and CQC Site Manager will share project QA/QC functions, including inspections; testing; reporting; and assisting in preparing and reviewing the formal submittals. The CQC system manager authority will include the ability to stop work in the event the CQC criteria are not meeting the contract specifications. The CQC system manager reports to the president of SCS Engineers. The CQC Site Supervisor, Cliff Leeper, is also the site superintendent, and reports to the project task manager and alternate CQC Manager, Mr. Joe Harrington. Mr. Harrington reports to Mr. Roberson.

The CQC system manager will provide assurance that all site activities, including that of subcontractors, suppliers, and vendors, comply with the requirements of the contract. This will be accomplished by comparison of project activities and functions with the QC requirements of the contract specifications. The CQC system manager will be vested with the authority to stop work if the QC criteria are not being followed.

The CQC system manager is also responsible for supervising CQC staff responsible for quality assurance related to the collection of samples for chemical analysis. The CQC system manager will serve as the point of contact for all QC-related communications with subcontractors and SCS Engineers project management. Concerns and comments by the CO related to quality management will be forwarded to the CQC system manager for action.

9.3.2 Contractor's Other Personnel

Quality control functions subsidiary to this CQC Plan may be performed by SCS Engineers' subcontractor, OMI. On-site personnel will assist the CQC system manager in other areas as required to fully implement the CQCP. The CQC system manager may delegate such duties to other contractor's personnel who may be assigned to the project on a temporary basis, such as field engineers and superintendents.

9.4 TESTING

Sampling and analysis will be conducted as necessary to monitor the pilot remediation process (Process Monitoring) and verify compliance with various regulatory or contract requirements (Compliance Monitoring). Analytical laboratories to be utilized for this project include the U.S. EPA laboratory at Manchester, other CLP labs under separate contract to U.S. EPA and Severn Trent Laboratories under contract to SCS Engineers.

The point of contact for Severn Trent Laboratories is:

Darla Powell
STL Laboratories
5755 8th Street East
Tacoma, WA 98424
Phone: 253-922-2310
Fax: 253-922-5047
Email: DPowell@stl-inc.com

This laboratory/testing firm meets specified requirements, certifications, and/or validation.

The Field Standard Operating Procedures for sample collection and the Laboratory Quality Management Plan are included in the Sampling and Analysis Plan (SAP).

9.5 SUBMITTALS

9.5.1 General

Submittals are divided into two classifications: "Government Approved" (GA) and "For Information Only" (FIO). All items on the Contract Data Requirements List (DD Form 1423) will be submitted. All submittals that require government approval will be scheduled and made prior to the performance of related activities or acquisition of the related materials or equipment. All submittal procedures will be in accordance with Section 01330, "Submittal of Contract Data," of the contract specifications.

Contract Data Requirements List (DD Form 1423)

All items on the Contract Data Requirements List will be checked and approved by the CQC system manager prior to submittal. Following final approval, the submittal will be signed and dated by the project manager.

Resubmittals

For GA submittals, the USACE CO will attach an Action Code to the submittal following review. Action Codes "A" (approved as submitted) or "B" (approved, except as noted) authorizes SCS Engineers to proceed with that work item. However, SCS Engineers acknowledges that this code does not relieve SCS Engineers of its responsibility to properly conduct that task. Action Codes other than "A" or "B" require SCS Engineers to make appropriate corrections and resubmit the material prior to proceeding with that work item. The CQC system manager will review each returned submittal with the site superintendent and project manager and establish a proper response action and time frame. These details will be noted in the Weekly QC Report.

9.6 VERIFICATION PROCEDURES

9.6.1 Controls

CQC is the means by which the Contractor ensures that the work, including that of subcontractors and suppliers, complies with the requirements of the contract. Reviews of project activities, procedures and documentation will be the main means of verifying compliance with the project specifications. Controls will be keyed to the proposed work sequence and for each definable feature of work (listed in Section 9 of this Plan) will include:

1. A review of the applicable standard operating procedures and operating and maintenance data including O & M manuals.
2. Safety checks including compliance with and upgrading of the safety plan and activity hazard analysis as needed.
3. Establishment of levels of workmanship and verify that they meet minimum acceptable workmanship standards.
4. Visually inspecting items not requiring laboratory testing.
5. Preparing and maintaining inspection checklists.
6. Coordinating site activity.
7. Maintaining copies of test results, inspection reports, certification papers and permits.
8. A check to assure that required control inspection and testing are provided.
9. A physical examination of required materials and equipment, to assure that they are on hand, and are stored as specified.
10. Resolution of all differences.
11. Review the activity hazard analysis with each worker.
12. Inform workers as to the acceptable level of workmanship required in order to meet contract specifications prior to the start of work.
13. Ensure, for new employees, all applicable requirements are discussed prior to on-site performance.

Routine checks shall be performed on the ongoing work to assure continuing compliance with contract requirements, including control testing. The checks shall be made a matter of record in the CQC documentation.

9.6.2 Followup

Follow-up checks shall be conducted and all minor deficiencies corrected or scheduled for correction within an appropriate timeframe. Major deficiencies, including items not covered by routine maintenance, shall be identified and an evaluation and proposal for repair activities submitted to prevent continuation of detrimental operations.

9.6.3 Deficiencies

A list of deficient items encountered during the inspections will be included in the CQC documentation with an estimated date by which the deficiencies will be corrected. The followup inspections will serve to ascertain that the deficiencies have been corrected. Correction of deficient items must be accomplished to the satisfaction of the CQC system manager and the CO to satisfy this contract.

9.7 OFF-SITE CONTROL

Facilities of off-site suppliers, labs, and disposal facilities may be surveyed as appropriate to ensure that all requirements of the contract are met and maintained. The facility will be notified of any deficiencies and will be required to submit a report of corrective actions taken. The contractor will inform the federal government of off-site surveys.

9.7.1 Documentation

The CQC system manager will maintain current records of all control activities. These will include factual evidence that the required control activities have been performed, including the number and results, nature of defects and causes for rejection, proposed remedial action and corrective actions taken. CQC records will cover both conforming and defective features and will include a statement that all supplies and materials incorporated in the work are in full compliance with the terms of the contract. Legible copies of these records on an appropriate form will be furnished to the federal government weekly.

Documentation will also include a field log book that contains detailed descriptions of the work performed at the site, testing performed, and deficiencies observed and/or corrected, etc. This field log book is to be used to document activities such that they may be reconstructed at a later date without having to rely on the memory of the person performing the work. The log book will also be used to generate the weekly QC reports.

9.7.2 Materials Certification

Copies of all purchase orders or subcontracts requiring receiving inspection will be given to the Quality Control manager or designated representative for receiving and record purposes. When the purchase order requires vendor certification of materials, equipment or supplies, such certification shall be verified as to accuracy and conformance and may be used in lieu of a test for those properties covered by the certification. Copies of all certifications received will be maintained in the Quality Control folder and will be available to the federal government upon request or submitted as provided in the contract specifications.

9.7.3 Calibration of Equipment

All contractor furnished measurement and testing equipment shall be calibrated and maintained in accordance with equipment manufacturer's recommendations. In order to ensure optimal operation of measurement and testing equipment, the following protocol will be implemented:

- Each instrument will be plainly and permanently numbered and operated only by those persons directly responsible for the equipment or personnel under their guidance.

- Each piece of equipment will be checked for accuracy as recommended by manufacturer for frequency of calibration. Required calibration of measurement and testing equipment will be conducted per manufacturer's recommendation.

- Measurement and testing equipment dropped, damaged, or believed to be inaccurate will be removed from service and recalibrated.

9.7.4 Revision Policy

Activities, programs, and procedures not covered in this Contractor Quality Control Plan, or proposals or additions to these standards, shall be discussed at meetings held for that purpose at such times and places the CQC system manager may select. The CQC system manager shall take such action to request acceptance from the federal government to incorporate such revisions as deemed necessary. A record shall be kept of such meetings and interested parties present, together with the subject matter reviewed. Such meetings shall be held as required by changes in the contract specifications for the purpose of reviewing the CQC Plan or to entertain revisions, additions, or deletions. Accepted revisions shall be incorporated in the plan as first revision, second revision, etc., and a revised index page shall be included.

9.8 REPORTING PROCEDURES

Current records of CQC operations, activities, and tests performed shall be maintained including the work of subcontractors and suppliers. These records will include the Weekly Quality Control Report and Quality Control Discrepancy Reports and shall include factual evidence that required quality control activities and/or tests have been performed.

9.8.1 Weekly Quality Control Report

The Weekly Quality Control Report will be signed and dated by the CQC Manager or his representative and will contain the following information:

a. Inspections conducted during the week.
   Check that materials are stored properly, work was done correctly, work methods and schedule have been discussed, and that safety and hazard analysis was addressed. Identify any safety hazards encountered, instructions given and corrective actions taken.
b. A list of job safety actions taken and safety inspections conducted. Indicate that safety requirements have been met including the results on the following:
   (1) Was a job safety meeting held? (If YES, attach a copy of the meeting minutes.)
   (2) Were there any lost time accidents? (If YES, attach a copy of the completed OSHA report.)
   (3) Was crane/trenching/scaffold/high voltage electrical/high work done? (If YES, attach a statement or checklist showing inspection performed.)
   (4) Was hazardous material/waste released into the environment? (If YES, attach a description of meetings held and accidents that happened.)
   (5) List safety actions taken and safety inspections conducted.
c. A list of the rework items identified, but not corrected.
d. A list of the rework items corrected from the rework items list along with the corrective action taken.
e. A list of submittals which have been checked for compliance with the technical specifications and submitted as required.
f. A "remarks" section which will contain pertinent information including directions received, quality control problem areas, deviations from the QC plan, deficiencies or delays encountered, QC meetings held, corrective direction given by the QC Organization and corrective action taken by the Contractor. Also note conflicts or errors in the O & M Manuals.
g. Copies of test reports and copies of reports prepared by all subordinate quality control personnel.

9.8.2 Quality Control Discrepancy Report

All Quality Control Discrepancy Reports (Appendix C) will be submitted with the weekly report as required to explain special problems, deficiencies, non-work items, unusual operations, etc.

9.8.3 Rework Items List

The QC Manager will maintain a list of work that does not comply with the Contract requirements, identifying what items need to be reworked, the date the item was originally discovered, the date the item will be corrected by, and the date the item was corrected. There is no requirement to report a rework item that is corrected the same day it is discovered. A copy of the "Rework Items List" will be included with the Contractor Weekly Quality Control Report. All items needing rework, including those identified by the Contracting Officer, will be included on this list.

All documentation will be submitted on a Weekly Quality Control Report form. A sample of this form is included in Appendix C.

9.9 QUALITY CONTROL PROCEDURES

9.9.1 Surveillance of Subcontractors' Operations

Surveillance of the subcontractors' operation is the responsibility of the CQC system manager. Major discrepancies that come to his attention will be recorded and transmitted to the related subcontractor. SCS Engineers' CQC system manager has authority to act directly with subcontractor representatives on routine quality control activities. Major discrepancies will be followed up on a daily basis. Upon correction of the major discrepancy, the date corrected will be noted and by whom.

SCS Engineers' CQC system manager will be supported by subcontractor on-site personnel, OMI's site superintendent and the SCS project manager. Surveillance of the subcontractor operations is the responsibility of the CQC system manager. The CQC system manager has the authority to act directly with subcontractor representatives on routine quality control activities.

9.9.2 Inspection Acceptance Procedures

All work shall be in accordance with the contract specifications. All rework or changes that change existing specifications must be authorized by the CO or the CO's designated representative. All remediation and operation and maintenance activity will be recorded on the CQC system manager's report. Work found in compliance with the specifications will be so noted. If discrepancies are found, they will be handled in accordance with inspection discrepancy procedures.

9.9.3 Inspection Discrepancy Procedures

The inspection system is intended to detect and correct all discrepancies in quality, workmanship, materials, equipment, supplies, and/or unauthorized deviations from contract requirements. The following procedures will be followed whenever a deficiency is encountered:

- Discrepancies will be recorded on the Quality Control Discrepancy Report form. Each discrepancy will be assigned a number by the recording CQC system manager. A concise statement giving the location and description of the discrepancy will be completed by the CQC system manager.

- When non-conforming materials, equipment, supplies or workmanship are rejected, the rejecting CQC system manager will initiate a discrepancy report and immediately furnish copies to the OMI site superintendent, the SCS project manager., and (if appropriate) OMI's off-site representative.
- Upon reviewing the discrepancy report, the project manager or the project manager's representative and the CQC system manager will examine the rejected items. If, in their opinion, any of the rejected items can be reworked to a useable condition, the discrepancy report will be so noted. However, if in their opinion the item cannot be reworked, either from a practical and economical standpoint, the item shall be scrapped and an entry will be made on the discrepancy report to that effect.
- Upon completion of rework on items specified for rework, the CQC system manager will be notified and will reinspect the items to determine if they then meet the contract requirements. If found acceptable, the discrepancy report will be so noted. From this point on, the items will be handled in the normal manner. If, however, the items are still not acceptable, the items will be scrapped and an entry made on the discrepancy report to that effect.
- The discrepancy report log will be periodically reviewed by the site superintendent and project manager with the CQC system manager to formulate a disposition of each listed, uncorrected discrepancy. They will establish timetables for final resolution of all discrepancies.

9.10 DEFINABLE FEATURES OF WORK

A definable feature of work is a task, which is separate and distinct from other tasks and has separate control requirements.
The definable features of work specific to this project are the following:

1. Management Plan
2. Mobilization
3. Boiler Plant Operation and Maintenance
4. Pilot Remediation System Operation and Maintenance
5. Treatment Plant Operation and Maintenance
6. Process and Compliance Monitoring
7. Groundwater Sampling and Analysis
8. Noise Monitoring
9. Data Reporting and Data Management
10. Health and Safety Training and Monitoring
11. Hazardous Waste Management and Disposal
12. Demobilization
13. Final Report

Table 9-1.
ORGANIZATION CHART

Cliff Leeper Project Site Supervisor Site Safety and Health Officer Site CQC Manager	206-855-8236 (W) 206-780-1711 (W) 206-780-1716 (fax) 206-715-7163 (cell) (b) (6) [redacted] (hm)	OMI, Inc. 5350 Creosote Place NE Bainbridge Is, WA 98110	omiwyk@omiinc.com
Richard Walker Maintenance Mechanic & Plant Operator	206-855-8236 (W) 206-780-1716 (fax)	OMI, Inc. 5350 Creosote Place NE Bainbridge Is, WA 98110	scsengineers@earthlink.net
Keith Allers Industrial Technician & Plant Operator	206-855-8236 (W) 206-780-1716 (fax)	OMI, Inc. 5350 Creosote Place NE Bainbridge Is, WA 98110	scsengineers@earthlink.net
Stanley Warner Industrial Technician & Plant Operator	206-855-8236 (W) 206-780-1716 (fax)	OMI, Inc. 5350 Creosote Place NE Bainbridge Is, WA 98110	scsengineers@earthlink.net
Bill DeHuff Industrial Technician & Plant Operator	206-855-8236 (W) 206-780-1716 (fax) 206-979-2674 (cell)	OMI, Inc. 5350 Creosote Place NE Bainbridge Is, WA 98110	omiwyk@omiinc.com
Tim Holt Boiler Operator	206-855-8236 (W) 206-780-1716 (fax) 206-979-2688 (cell)	OMI, Inc. 5350 Creosote Place NE Bainbridge Is, WA 98110	omiwyk@omiinc.com
Rick Smith Boiler Operator	206-855-8236 (W) 206-780-1716 (fax) 206-979-2688 (cell)	OMI, Inc. 5350 Creosote Place NE Bainbridge Is, WA 98110	omiwyk@omiinc.com
Tom Tiam Boiler Operator	206-855-8236 (W) 206-780-1716 (fax) 206-979-2688 (cell)	OMI, Inc. 5350 Creosote Place NE Bainbridge Is, WA 98110	omiwyk@omiinc.com
Bob Wagner Boiler Operator	206-855-8236 (W) 206-780-1716 (fax) 206-979-2688 (cell)	OMI, Inc. 5350 Creosote Place NE Bainbridge Is, WA 98110	omiwyk@omiinc.com
Stephen Meininger Regional Business Mgr	443-535-9408 (W) 443-745-1774 (cell) 443-535-9409 (fax)	(b) (6) [redacted] Clarksville, MD 21029	smeining@omiinc.com
USACE Seattle District (Owner's representative)			
Kathy LeProwse USACE Project Manager	206-764-3505 (W)	USACE Seattle District CENWS-PM-EM P.O. Box 3755 Seattle, WA 98124-3755	Mary.K.LeProwse@usace.army.mil
Travis Shaw USACE Site Manager	206-764-3527 (W) 206-855-4178 (site) 206-915-8892 (cell) 206-855-4177 (fax)	USACE Seattle District CENWS-EC-TB-ET P.O. Box 3755 Seattle, WA 98124-3755	Travis.C.Shaw@usace.army.mil
David E. Roden USACE COR	206-764-3448 (W)	USACE Seattle District CENWS-PM-EM P.O. Box 3755 Seattle, WA 98124-3755	David.E.Roden@nws02.usace.army.mil
Sharon Gonzalez USACE Contract Administrator	206-764-6696 (W) 206-764-6817 (fax)	USACE Seattle District CENWS-CT-CB-CU P.O. Box 3755	Sharon.J.Gonzalez@usace.army.mil

10.0 SITE-SPECIFIC HEALTH AND SAFETY PLAN (SSHP)

11.0 SPILL AND EMERGENCY RESPONSE PLAN

11.1 INTRODUCTION

This Spill Prevention and Emergency Response Plan presents the requirements and procedures that SCS Engineers (SCS) will follow during the operation of the Thermal Treatment Pilot Remediation and associated Groundwater Treatment Plant (GWTP) activities at the Wyckoff/Eagle Harbor Superfund Site in case of accidental release of pollutants to the environment.

11.2 OBJECTIVES

The objectives of this Spill Prevention and Emergency Response Plan are the following:

- To reduce the potential for spills of hazardous materials, wastes, or petroleum products into the environment during remedial actions in quantities that could be harmful to human health or the environment.
- To provide the emergency procedures to be followed in the event of a spill of petroleum products or hazardous substances at the Wyckoff/Eagle Harbor Superfund Site.

11.3 LIST OF APPLICABLE USACE GUIDE SPECIFICATIONS

Section 01451, Contractor Quality Control Services
Section 01401, Project Management
Section 01410, Environmental Protection
Section 01351, Safety, Health and Emergency Response

11.4 SPILL PREVENTION

SCS will manage any hazardous materials or petroleum products stored and used on-site in a manner that prevents their escape into the environment. An inventory of hazardous materials used on-site is presented in Table 11-1. Table 11-1 will be updated as necessary if additional significant material storage is required at the site.

All of the fuel oil and chemical ASTs present on the site are provided with secondary containment. Fuel oil is stored at the boiler facility in double-walled steel tanks, while all the GWTP ASTs are kept on a concrete containment pad.

Daily inspections of potential release sites will be conducted for spills or leaks by SCS in conjunction with the other routine O&M inspections. These inspections will be scheduled and tracked using the Maintenance Pro facility maintenance Program.

Table 11-1

Hazardous Materials Inventory

Material Name[1]	No. Containers	Wt./Volume per Container	Container Location	Major Chemical Ingredients
#2 Fuel Oil	One AST	20,000 gal	Boiler Plant	Petroleum Hydrocarbons
#2 Fuel Oil	One AST	6,000 gal	Boiler Plant	Petroleum Hydrocarbons
Extracted Product	One AST	10,015 gal	GWTP	Creosote and PCP
Caustic Mix	One AST	1,000 gal	GWTP	NaOH
Acid Mix	One AST	500 gal	GWTP	HCL and H_2SO_4

[1] Material Safety Data Sheets (MSDSs) attached.

11.5 RESPONSIBILITIES

A list of spill response personnel names, titles, contact numbers, and responsibilities is presented in Table 9-3. SCS is responsible for managing all aspects of spill containment and clean-up activities on-site resulting from the operation of the steam injection pilot, the groundwater/product extraction system, and the GWTP.

In the event of a significant release from the boiler fuel tanks or the GWTP is observed, on-site personnel must contact Government Site Manager. The Government Site Manager shall notify the USACE Project Manager of emergency response initiation. The Corps of Engineers Project Manager is to inform EPA of response action.

Any release of petroleum products or other chemicals due to the SCS's or its subcontractor's activities, will be handled by SCS or their subcontractors. Government Site Manager/SSHO must be notified.

Table 11-3
Responsibilities for Spill Response

Name	Company Title	Phone/ Pager #	Responsibility
Joe Harrington	SCS Project Manager	(425) 746-4600	Project Management/Reporting
David Roberson	SCS Quality Control Coordinator	(425) 746-4600	Project Quality Control
Cliff Leeper	SCS/OMI Site Superintendent	(206) 715-7163	On-Site Supervisor
Travis Shaw	USACE Site Manger	(206) 915-8892	Site Manager

The following information should be provided to all emergency personnel, if known:

- Source of spill.
- Type of material spilled.
- Approximate volume of the spill.
- Time/date discovered.
- Has the flow stopped?
- Are their any injuries or property damage?
- Has a body of water been affected or threatened?
- Cause of incident.

11.6 NOTIFICATIONS

SCS personnel or subcontractors discovering a spill will immediately notify the SCS Project Manager or Quality Control Coordinator, who will subsequently inform the USACE Site Manager. All reporting to external agencies will be the responsibility of the USACE. The level of notification required will depend on the severity of the spill. Notification procedures are summarized in Table 9-4. Emergency phone numbers are listed in Table 9-5.

Table 11-4
Emergency/Spill Response Notification Procedures

1.	Significant release of petroleum or GWTP chemicals is observed at the boiler facility or on the GWTP containment pad.
2.	SCS or subcontractor to contact USACE Site Manager.
3.	Site Manager to notify Corps of Engineers Project Manager of response initiation.
4.	Corps of Engineers Project Manager to inform EPA of response action
5.	Any product or chemical release due to SCS' or its subcontractor's activities, will be handled by SCS. USACE Site Manager must be notified. SCS will follow procedures identified in RAMP for response/cleanup.
6.	EMERGENCY RESPONSE MUST BE DOCUMENTED IN DAILY REPORT FOR EACH CONTRACTOR INVOLVED IN THE IDENTIFICATION/CLEANUP OR THE RELEASE AND FOR THE GOVERNMENT ONSITE REPRESENTATIVE.

11.7 LEVEL I SPILL

A Level I spill would be within the cleanup capability of the facility and, therefore, would not require Bainbridge Island Fire Department (911) notification. An example of a Level I spill would be a 25-gallon localized upland release of hydraulic fluid from a ruptured line on a piece of heavy equipment.

11.8 LEVEL II SPILL

A Level II spill would be beyond the cleanup capability of the facility and would require Bainbridge Island Fire Department (911) notification. The SCS site supervisor and USACE Site Manager share primary responsibility for contacting the Fire Department. However, in the event of an immediate threat to human health or the environment, all onsite personnel are responsible for contacting onsite emergency personnel, as well as outside emergency services.
An example of a Level II spill would be a 100-gallon product recovery storage tank spill that escaped the GWTP containment pad and escaped into Puget Sound. Other criteria for fire department notification are a threat to health and safety, or off-site migration either overland or through some sort of conveyance such as storm drains or ditches. That is, all spills outside the facility or that threaten surface water, or other resources outside the facility, require a Level II response. The USACE directs the cleanup, drawing on technical assistance of the environmental contractor and any external resources deemed necessary.

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) requires that a release to the environment of any hazardous substance over its reportable quantity be reported to the National Response Center (40 CFR 302.6). The USACE will determine the appropriate level of spill notification required.

Table 11-5
Emergency Phone Numbers

NAME	PHONE #
National Response Center	(800) 424-8802
Bainbridge Island Fire Dept.	911 Business # (206) 842-7686
Bainbridge Island Police	911 Business # (206) 842-5211
USACE PM, Kathy LeProwse	(206) 764-3505
USACE Site Manager, Travis Shaw	(206) 855-4178 (site) (206) 915-8892 (cell)
USACE COR, Ginny Dierich	(206) 764-3265
SCS/OMI (Site), Cliff Leeper	24 hr (206) 715-7163
SCS PM, Joe Harrington	(425) 746-4600 (office) (b) (6) (home)
SCS QCC, Dave Roberson	(425) 746-4600 (office) (206) 789-5963 (cell)
SCS SHSO, Brian Doan	(425) 746-4600

11.9 REPORTING

SCS will report any spills that occur on site using a spill response incident report form (Appendix C). This form requires reporting the date and time of the spill, its location, the material spilled, its quantity, the time period over which the material was spilling to the environment, list of any body of water contaminated, response to the spill, and other pertinent information.

11.10 SPILL CONTAINMENT AND RESPONSE

Successful response to a spill incident requires effective, immediate actions, prompt notification, and timely commitment of resources for containment and cleanup. For a Level II spill, the site must be secured and access controlled as rapidly as possible. Site personnel will follow response procedures described here in the event of a spill of hazardous materials or petroleum products to either prevent their release to the environment, or to contain them should they be released. Following initial emergency response actions and notifications, indoor spills will be handled by plugging or blocking any floor drains with available sorbents or blocking materials. For outdoors spills, spill response equipment should be deployed as soon as possible to halt the spread of the spill. Spill containment on land consists of enclosing the spilled liquid with a dike of solid sorbent (such as oil dry or sawdust) and closing off any entrances to nearby ditches and sewers. Absorbent materials will be available on-site for immediate use. Emergency spill kits are maintained by SCS on the north end of the GWTP and near the center of the extraction and monitoring well field. Spilled petroleum products or other contaminated materials will be disposed of in accordance with the Materials Management Plan.

11.11 CLEANUP AND DISPOSAL

SCS will dispose of spill containment materials used on water and land properly, in accordance with the Materials Management Plan. Sources of ignition will be avoided in cleanup because materials may be flammable, and adequate ventilation must be provided. Enough sorbent will be used to soak up all the spilled liquid. Any pooled product will be pumped to the on-site treatment system.

12.0 ENVIRONMENTAL PROTECTION PLAN

12.1 INTRODUCTION

This Environmental Protection Plan (EPP) was prepared in accordance with Section 01410 – Environmental Protection, of the technical specifications for MARC contract DACW67-01-D-1007 Task Order 0003, Thermal Remediation Pilot O & M, Wyckoff/Eagle Harbor Superfund Site (Wyckoff), Bainbridge Island, Washington, and other resources listed below. This EPP presents the steps and procedures that site workers, either temporary or permanent employment, will utilize during applicable work activities to minimize negative impacts to human health and the environment.

12.1.1 Objectives

The objective of the EPP is to minimize environmental pollution and damage as a result of pilot remediation, operation, and maintenance (O&M) carried out as part of the Wyckoff remedial actions. Environmental pollution and damage include the presence of chemical, physical, or biological elements or agents that adversely affect human health and welfare: unfavorably alter ecological balances of importance to human life; affect other species of importance to humankind; or degrade the utility of the environment for aesthetic, cultural, and/or historic resources. The environmental resources within the project boundaries and those outside the limits of permanent work will be protected during the entire duration of this contract.
Pilot Remediation and O&M activities will be under surveillance, management, and control to avoid pollution of surface water and earth, and will use best management practices to minimize environmental effects of the activities. The EPP may need altering or updating if site conditions change.

12.1.2 Responsibility

Contractors performing work at the site will comply with this EPP and ensure compliance by its subcontractors.

12.1.3 List of Federal, State, and Local Laws and Regulations

Code of Federal Regulations (CFR):

- 40 CFR 261 through 270 Hazardous Waste Standards.

EPA documents and permits:

- Guidance Specifying Management Measures for Sources of Non-point Source Pollution in Coastal Waters.
- Final Water Quality Certification, East Harbor Operable Unit and Groundwater/Soils Operable Unit, Wyckoff/Eagle Harbor Superfund Site, July 18, 2000.

State of Washington:

- Revised Code of Washington (RCW) 27.44 (Indian Graves and Records) and 27.53 (Archeological Sites and Resources)
- Washington Administrative Code (WAC) Chapter 173-201A (Water Quality Standards)

12.1.4 List of Applicable USACE Guide Specifications

The following technical specifications for MARC contract DACW67-01-D-1007 Task Order 0003, Thermal Remediation Pilot O & M, Wyckoff/Eagle Harbor Superfund Site, Bainbridge Island, Washington, were used in the development of this EPP:

- Section 01410, Environmental Protection
- TE-1, General Description of Facilities to be Operated and Maintained

12.2 ENVIRONMENTAL MONITORING/PROTECTION

Any equipment used previously at sites other than Wyckoff will be inspected for proper decontamination prior to use at the Wyckoff site. Special care will be given to removal of soil residuals and egg deposits from plant pests.

All survey monuments, markers, and structures located at the site will be protected during O&M activities.

Worker protection will be addressed in the Site Safety and Health Plan (SSHP). The site will be divided into work and exclusion zones. In addition, the facility access will be identified in the SSHP.

12.2.1 Preservation of Historic, Archaeological, and Cultural Resources

Previous investigations during the remedial design phase did not identify any resources that require mitigation (LAAS Technical Report #98-16, Dec. 1999. EPA Superfund Eagle Harbor/Wyckoff Facility Cultural Resources Assessment). No excavation is planned as part of this contract, so it is unlikely that any as yet undiscovered cultural resources will be encountered during this O&M phase of the work. If during any emergency or unplanned excavation or other construction activities any previously unidentified or unanticipated resources are discovered or found, all activities that may damage or alter such resources shall be temporarily suspended. Resources covered by this paragraph include but are not limited to: any human skeletal remains or burials; artifacts; shell, midden, bone, charcoal, of other deposits; rocks or coral alignments, pavings, wall, or other constructed features; and any indication of agricultural or other human activities. Upon such discovery or find, the contractor will immediately notify the USACE contracting officer's representative (COR). While waiting for instructions, the contractor shall record, report, and preserve the finds in accordance with appropriate procedures for the protection of the resources (Indian Graves and Records, RCW 27.44 and Archeological Sites and Resources, RCW 27.53)

12.2.2 Protection of Biological Resources

The contractor and its subcontractors will minimize interference with, disturbance to, and damage of fish and wildlife. Federal endangered, threatened, and candidate species potentially within the project area that must be protected are the Puget Sound chinook salmon, the bull trout, the Steller sea lion, the humpback whale, the bald eagle, the leatherback sea turtle, and the marbled murrelet. This contract does not anticipate any off-shore work so aquatic species are not expected to be affected. If emergency repairs or off-shore work is required, to the extent possible, in-water work will be allowed only during the in-water construction window of July 15 through February 20 to protect listed and candidate fish species. Work required outside this window will be minimized to include only emergency service and maintenance.

The contractor and its subcontractors will not anchor, ground barges, excavate, or generate excessive prop wash in eelgrass beds or kelp beds unless approved by the COR. The eelgrass beds are at approximately –0.5 feet Mean Lower Low Water (MLLW) and parallel the eastern and northern shoreline of the facility. Eelgrass is present along the intertidal area in the vicinity of the waste-water treatment plant.

At all times in performing the work, steps will be taken as required to prevent interference or disturbance of safe passage to spawning areas of anadromous and other fish species of concern (e.g., surf smelt). Visual observation in the project area will be performed. If any distressed or dead fish or wildlife are observed, work will be stopped immediately and the COR notified.

12.2.3 Protection of Features

Certain trees or other vegetation may be designated to be left standing within cleared areas, at the discretion of the USACE. Trees and vegetation left standing will be protected from damage incident to O&M activities by the erection of barriers or by other means as the circumstances require.

12.2.4 Protection of Air Quality

Contractor provided portable equipment that generates air emissions of concern will comply with the local air authority emission regulations. Fixed or permanent equipment emission compliance will be a combined responsibility of the contractor and USACE. Open burning of material or waste will not be allowed at Wyckoff. Standard dust suppression methods will be used at Wyckoff to avoid suspension of airborne dust particulates.

12.2.5 Protection of Water Quality

The discharge of toxic materials or petroleum products into marine waters is prohibited. The contractor will take all precautions necessary to prevent the introduction of pollutants, either directly or indirectly (non-point sources), to surface waters. In addition, pollutants may not be carried to receiving waters in stormwater runoff from such sources as oil and grease from motor vehicles and equipment, treatment plant or boiler plant and equipment, stockpiles, or refuse. If necessary, monitoring of water areas for dissolved oxygen and turbidity during remediation and O&M activities will be performed by USACE. The contractor will be responsible for monitoring work areas for creosote releases, spills of fluids from equipment, and distressed or dying fish. The contractor will use best management practices to protect surface and ground water quality, including secondary containment of hazardous materials, use of silt fences to minimize runoff, and use of absorbent booms or pads in the water or on the ground surface. Sorbent pads and other items will be available for immediate use in the event of a product release. Sheens or product not absorbed by the boom will be absorbed using sorbent pads or other methods. Portions of the boom will be replaced when saturated or no longer functional. Disposal of discarded booms and pads will be in accordance with the Materials Management Plan developed for Wyckoff.

12.2.6 Waste Disposal

The contractor will containerize any solid wastes generated on-site and manage them in a manner that will prevent further contamination. Waste disposal will be in accordance with the Materials Management Plan.

12.2.7 Spill Prevention and Emergency Response

The contractor will consult the Spill Prevention and Emergency Response Plan developed for Wyckoff remedial actions for spill prevention and control procedures.

12.3 TRAINING

The contractor and subcontractor site personnel will be trained in environmental protection and pollution control. Training will include methods of detecting and avoiding pollution; familiarization with pollution standards, both statutory and contractual; installation and care of devices, vegetative covers, and instruments required for monitoring; and recognition of protected species. Documentation of training (date of training, list of personnel attending, their positions/responsibilities for work under this contract, and their signature acknowledging receipt of this training) is provided in Table 12-1.

12.4 NOTIFICATION

USACE will notify the contractor in writing of any observed noncompliance with the previously mentioned Federal, State, or local laws or regulations or other elements of this Environmental Protection Plan. The contractor will, after receipt of such notice, inform the COR of proposed corrective action and take such action when approved, or sooner if imminent hazard exists.

Table 12-1
Training Documentation

Training Unit Title: ____________

Instructor: ____________________

Training Objectives:____
____
____

Attendee	Signature	Date

13.0 WASTE MANAGEMENT PLAN

13.1 INTRODUCTION

This document describes SCS Engineer's proposed handling, staging, and final disposition of the waste material generated during operations and maintenance of the Thermal Remediation Pilot Contract at the Wyckoff/Eagle Harbor Superfund Site.

13.1.1 Purpose and Objective

The purpose of this document is to inform the USACE and SCS Engineers and OMI employees of the proposed procedures and requirements for waste management associated with the Thermal Remediation Pilot Project. The objective is to provide direction to employees, be protective of the human health and the environment, and prevent cross-contamination of uncontaminated material.

13.1.2 Project Background

The Wyckoff/Eagle Harbor Superfund site is located on Bainbridge Island, Washington, on the southern shoreline of Eagle Harbor near the harbor entrance. The Thermal Remediation Pilot Project is part of the Wyckoff/Eagle Harbor Superfund Site, which includes property formerly occupied by the Wyckoff Company (now Pacific Sound Resources). A former wood-treating facility operated on the site from 1905 through 1988. In addition to treating wood, other site operations included storage of process-related products such as aromatic oil, creosote, and other chemicals; wastewater treatment and discharge; wood preserving; and storage of treated wood and poles. Preservative chemicals were delivered to the facility by barge and ship and stored in tanks on the property. Contaminants of concern from the facility through spills, drippage, leaks, and direct discharge have contaminated the surface and subsurface soils, groundwater, and the adjacent harbor.

The contaminants of concern resulted from the former wood processing activities. The contaminants of concern are classified under the Resource Conservation and Recovery Act (RCRA) 40 CFR 261.31 as listed wastes. These wastes include F032 - wastewaters from process residuals, preservative drippage, and spent formulations from wood processes that used chlorophenolic formulations; F034 - wastewater process residuals, preservative drippage, and spent formulation from wood preserving processes generated at plants that used creosote formulations.

13.2 KEY PERSONNEL

This section identifies the roles and responsibilities of the key personnel associated with waste materials management during the thermal remediation activities. SCS Engineers and OMI key personnel and responsibilities are described below; their resumes are included as Appendix 1.

13.2.1 Contract Manager and Health and Safety Manager (SCS Engineers)

The contract manager for this project will be Joe Harrington. Mr. Harrington will have overall responsibility for work progress and coordination, and quality control. Mr. Harrington will communicate directly with the USACE on-site representative on overall work schedule, procedures, and requirements and resolve any broad conflicts and coordination issues.
Mr. Harrington will also be the Health and Safety Manager (HSM) for this project. He will be responsible for development, implementation, oversight, and enforcement of the Site Health and Safety Plan (SHSP).

13.2.2 Site Supervisor and Site Safety and Health Officer (OMI)

The site supervisor for this project will be Cliff Leeper. Mr. Leeper will be responsible for daily activities which include operations, work coordination, and quality control. Mr. Leeper will schedule daily activities and coordinate with SCS subcontractors to minimize conflicts and resolve issues. The supervisor will be responsible for compliance with the project contract documents. In addition, the supervisor will report to the contract manager and will communicate directly with the USACE's on-site representative for the daily activities and to resolve conflicts and issues.
The Health and Safety Officer (HSO) for this project will be Cliff Leeper. Mr. Leeper will be responsible for compliance with the project SHSP. In addition, the HSO will be responsible for implementing safe work practices and procedures for the specific tasks performed on-site. The HSO will also have the responsibility of enforcing the safety requirements for SCS subcontractors. The HSO will have the authority to stop work, if he deems a situation to be non-compliant with safe work practices as established in the SHSP. The HSO will report directly to the HSM and communicate directly with the USACE's on-site representative.

13.3 14.2.3 Contractor Quality Control System Manager (SCS Engineers)

The Contractor Quality Control (CQC) system manager for this project will be Dave Roberson. Mr. Roberson will be responsible to ensure administrative as well as technical compliance with the project requirements. The CQC will examine the procedures as well as the documentation of the work practices for compliance. The CQC will act independently but will communicate with the site supervisor and with the USACE.

13.4 WASTE MATERIAL HANDLING, STORAGE, AND DISPOSAL

This section presents the nature and source of waste material that will require handling, storage, and disposal. The materials consist of solid waste and hazardous waste.

13.4.1 Solid Waste

The solid waste that will be generated during project activities will include municipal type such as material packaging and wrapping, food waste, and miscellaneous non-recyclable items such as small unused portions of material and supplies. No recycling of solid waste materials will occur on the site.

Small trash receptacles will be located in the trailers and the boiler building electrical room. The location of the small receptacles will eliminate accidental disposal of site hazardous waste as solid waste. The receptacles will be emptied as needed, but at least once every other day. The waste will be bagged and placed in the site dumpster.

A small roll-around solid waste site dumpster will be located near the entrance to the facility. The waste bin will be emptied weekly and disposed in a municipal solid waste landfill.

13.4.2 Hazardous Waste

The anticipated hazardous wastes that will be generated and handled during project activities are listed below;

Activity	Waste
Product/Groundwater Extraction	NAPL product
	Contaminated Groundwater
	Contaminated Vapors
Waste Water Treatment	Spent granular reactivated carbon
	NAPL product
	Spent filter media
	Biosolids and sludge
	Sump, aeration tank, and separator solids
Spill cleanup	Used sorbent and absorbent pads
Sampling and O&M activities	Personal protective equipment
	Used sampling equipment and supplies
On-site laboratory waste	Spent lab chemicals and wastes

These hazardous waste materials will be stored on site as listed below:

Spent granular reactivated carbon; This waste material will be stored on-site until it is removed for disposal as listed in the Spent Carbon Unloading and New Carbon Loading Standard Operating Procedure (SOP), dated 2/5/97.

NAPL product; This liquid waste will be handled and stored on-site until it is removed for disposal as listed in the Well Probing SOP, dated 8/21/01 and Product Pumping – PW-1 through PW-9 SOP, dated 8/22/01.

Spent filter media, biosolids and sludge, sump, aeration tank, and separator sediments, used absorbent pads, and personal protective equipment; Until removed for disposal, these wastes will be stored in sealed 55 gallon drums. Full and partially full drums will be stored on the decontamination pad.

All hazardous waste materials will be disposed at hazardous waste landfills. The waste disposal date for the items will be decided by the USACE. Disposal of these items will commence when the USACE approves the related Contract bid item.

Upon approval of the bid item, the following information will be presented to the USACE;

A written commitment to the direct transportation of the waste to an approved hazardous waste facility.

A description of the proposed waste hauling route.

The hazardous landfill disposal facility name.

13.5 SUBCONTRACTOR INFORMATION

This section presents the service vendors SCS Engineers will use for this project.

13.5.1 Solid Waste

The roll around dumpster will be provided and serviced by Bainbridge Disposal. The company information is presented below:

Bainbridge Disposal
PO Box 10386
Bainbridge Island, WA 98110
Ph 206-842-4882

The waste will be disposed in a regional solid waste landfill.

13.5.2 Hazardous Waste

The hazardous waste service and transportation will be provided by two companies. Each company with corresponding waste material handled and removed from the site is presented below:

Clean Environmental Concepts Inc.
PO Box 745
Vancouver, WA 98666
360-699-7392

Waste material; Spent granular reactivated carbon

Safety Kleen Corporation

117 Frontage Road North
Suite D
Pacific, WA 98047
Ph 253-288-2814

Waste material; NAPL product, spent filter media, biosolids and sludge, Sump sediments, aeration tank sediments, separator sediments, used absorbent pads, personal protective equipment, and analytical lab waste

The waste will be disposed in a regional hazardous waste landfill.

13.6 DOCUMENTATION

This section presents the documentation of disposed waste materials.

13.6.1 Solid Waste

The only documentation that will be recorded for solid waste disposal is monthly invoices from the vendor.

13.6.2 Hazardous Waste

For hazardous waste, the "complete manifest package" will be provided that will include, but is not limited to, all hazardous waste manifests, hazardous material shipping papers, waste profile sheets, land disposal restriction notification and certification forms, and any other supporting documentation, as applicable, including waste disposal history, any analytical results, material safety data sheets (if appropriate), the specific type of packaging, markings, labeling, and placards offered to the transporter.

The CQC officer will review the complete manifest package and shipping documentation for the hazardous waste and certify as correct the information contained on the Hazardous Waste Manifest, Waste Profile Sheets, Land Disposal Restriction Notification and Certification Forms, Bills of Lading, and supporting documentation. When review is completed, these documents will be provided to the USACE on-site representative for approval prior to shipment of waste off-site.

14.0 REFERENCES

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———. 1999. *Thermal Effects Study Management Plan, Wyckoff/Eagle Harbor Superfund Site, Groundwater Operable Unit.* Prepared for U.S. Environmental Protection Agency, Region 10.

U.S. Environmental Protection Agency (USEPA). 2000. *Record of Decision: Wyckoff/Eagle Harbor Superfund Site, Soil and Groundwater Operable Units, Bainbridge Island, Washington.* U.S. Environmental Protection Agency, Region 10, Seattle, Washington.

APPENDIX A

APPENDIX A

Field Sampling Plan and Quality Asssurance Project Plan

FIELD SAMPLING PLAN

Thermal Treatment Pilot Study
Wyckoff Facility and Groundwater Operable Units
Wyckoff/Eagle Harbor Superfund Site
Kitsap County, Washington

Prepared for:

U.S. Environmental Protection Agency
Region 10
1200 6th Avenue
Seattle, Washington 98101

Prepared by:

U.S. Army Corps of Engineers
Seattle District
4735 East Marginal Way South
Seattle, Washington 98134

and

SCS Engineers
2405 140th Avenue NE
Suite 107
Bellevue, Washington 98005-1877

November 2002

Field Sampling Plan

Thermal Treatment Pilot Study
Wyckoff Facility and Groundwater Operable Units
Wyckoff/Eagle Harbor Superfund Site
Kitsap County, Washington

APPROVAL PAGE

Approved ______________________________ Date________
EPA Region 10 Remedial Project Manager

Approved ______________________________ Date________
EPA Region 10 Quality Assurance Manager

Approved ______________________________ Date________
USACE Project Manager

Approved ______________________________ Date________
USACE Site Manager

Approved ______________________________ Date________
SCS Contract Manager

Approved ______________________________ Date________
SCS Quality Control Manager

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1.0 INTRODUCTION

The U.S. Army Corps of Engineers (USACE) is providing remedial design and remedial action services for the U.S. Environmental Protection Agency (EPA) Region 10 for the Wyckoff/Eagle Harbor Superfund Site, located on Bainbridge Island, Washington. USACE has designed a pilot study that will determine the effectiveness of innovative thermal remediation to enhance the recovery of nonaqueous-phase liquids (NAPLs) from the site. This work will be performed to meet the requirements of the Record of Decision (ROD) for the Soils and Groundwater Operable Units (OUs) (USEPA 2000).

The EPA has selected in-situ thermal technology as the remedy for clean up of soil and groundwater contamination at the Wyckoff/Eagle Harbor Superfund Site. The purpose of the pilot study falls into two broad categories: a) to assess the likelihood that a full-scale thermal remediation will achieve the cleanup goals for the site; b) to provide information for implementation of the potential full-scale thermal remediation. The pilot study design is based on meeting these objectives.

The purpose of this document is to present the procedures for the sampling and analysis activities proposed in support of the Thermal Remediation Pilot Study at the Wyckoff facility, Soils and Goundwater OUs, Wyckoff/Eagle Harbor Superfund Site. The Sampling and Analysis Plan consists of two stand-alone sections. The first section is the Quality Assurance Project Plan (QAPP), which presents the planning, strategy and procedures for site-wide data collection conducted on-site. The second section (this document) is the Field Sampling Plan (FSP), which is the procedural implementation manual consistent with the QAPP.

These stand-alone sections, along with the Site Specific Health and Safety Plan (SSHP), which presents a description of field procedures to protect personnel from hazards that may be presented by sampling activities, are appendices of the Remedial Action Management Plan (RAMP). The RAMP describes and integrates planning, strategy, procedures and implementation for site-wide activities during the Thermal Remediation Pilot Study.

1.1 OBJECTIVES

The Wyckoff Thermal Remediation Pilot Study is designed to meet the nine primary objectives of the study described in the Record of Decision (ROD) for the Soil and Groundwater Operable Units (OU's). These nine objectives can be divided into three broad categories: performance assessment, potential impacts of full-scale thermal treatment on the environment and surrounding community, and process monitoring. The specific project objectives described in the ROD are presented below:

Performance Assessment Objectives

- Demonstrate that thermal remediation technologies will remove substantially all mobile NAPL from the Pilot Study treatment area.

- Demonstrate that the post-thermal treatment concentrations of NAPL constituents dissolved in groundwater that move from the site to Eagle Harbor and Puget Sound will not exceed marine water quality criteria, surface water quality and sediment standards at the mud line.

- Demonstrate that surface soil (0 to 15 ft) concentrations within the Pilot Study area attain MTCA Method B cleanup levels.

Community and Environmental Impacts of Full-Scale Thermal Remediation Objectives

- Determine the potential impacts (noise, air emissions, lower aquifer and odors) of full-scale thermal treatment to the surrounding community.

- Evaluate the possible adverse effects that full scale thermal treatment may have to Eagle Harbor and Puget Sound near shore marine habitats.

Process Objectives

- Evaluate operational approaches to thermal remediation that may impact the removal of NAPL, such as steam movement and recovery of NAPL from the aquitard.

- Evaluate treatment plant performance during the Pilot Study to allow optimization of operations and monitoring mass balance of contaminant removal.

- Evaluate microbial populations before and after thermal treatment to assist in determining long-term contaminant destruction.

- Evaluate contaminant oxidation rates during thermal treatment to assist in mass balance calculations.

1.2 SITE LOCATION AND DESCRIPTION

The Wyckoff/Eagle Harbor Superfund site is located on Bainbridge Island, Washington, on the southern shoreline near the entrance to Eagle Harbor (Figure 1-1). The site has been divided into four operable units (OUs):

- Wyckoff Soil OU: surface and subsurface soil extending to the maximum elevation of the water table (or other fluid boundary)

- Wyckoff Groundwater OU: subsurface soil and groundwater beneath the maximum elevation of the water table (or other fluid boundary) extending to the sheet pile containment wall

- West Harbor OU: intertidal and subtidal surface sediments located within the West Harbor OU boundary

- East Harbor OU: intertidal and subtidal surface sediments located within the East Harbor OU boundary

The focus of the Thermal Remediation Pilot Study is the Pilot Study area in the Former Process Area within the Soil and Groundwater OUs. A site plan of the Former Process area is included as Figure 1-1. The Pilot Study area comprises approximately 12% of the surface area of the Former Process area (Figure 1-2). The entire Wyckoff property occupies approximately 57 acres (about 18 of which encompass the Soil OU), including a spit with about 0.8 miles of shoreline extending northward into Eagle Harbor. The spit has been extended and filled at least twice prior to the 1950s, and was the location of wood treatment activities that have caused the current soil and groundwater contamination.

The Wyckoff Soil and Groundwater OUs occupy a relatively flat lowland and intertidal area bounded by a densely vegetated bluff on the south. The lowland area has an average elevation of approximately 10 feet NGVD while the hillside area rises to elevations above 200 feet. A small stream flows north from the hills above the western arm of the property into a culvert that discharges into Eagle Harbor. The north and west portions of the spit are bounded by Eagle Harbor, and Puget Sound abuts the eastern margin of the spit.

1.3 SITE HISTORY

Prior to 1904, the Wyckoff property was owned by a sand mining operation and a brickyard. From 1904 through 1988, the site was used for the treatment of wood products (e.g., railroad ties and trestles, telephone poles, pilings, docks and piers) by a succession of owners and companies. Chemicals used at the site include creosote, pentachlorophenol (PCP), solvents, gasoline, antifreeze, fuel, waste oil and lubricants. These chemicals were stored in above-ground storage tanks, conveyed through above- and below-ground piping, disposed in sumps, spilled and buried on site.

EPA began an investigation of the property in 1971, and the site was subsequently placed on the National Priority List (in 1987). In 1988, the Wyckoff Company ceased all operations on the property. In 1993, EPA assumed management of the Soil and Groundwater OUs, and in 1994 the assets of the former Wyckoff Company (now Pacific Sound Resources) were placed into an environmental trust.

All wood-treatment structures in the lowland portion of the site, including buildings, foundations, tanks, pipelines and sumps, were removed between 1988 and 1997. The West Dock was removed in December 1998.

In 1989, Pacific Sound Resources (PSR) completed the design and construction of the groundwater treatment plant in response to EPA's Consent Decree No. 1088-02-17-106. This groundwater treatment plant (GWTP), monitoring and extraction wells, and a conveyance piping system for groundwater remediation are in place and in use.

The GWTP was designed and constructed with both biological and physical/chemical unit processes, which included activated carbon. The final design flow for the biological processes was 65 gpm and 100 to 120 gpm for the physical/chemical unit processes (Fahrenthold and Associates, August 1989). Effluent discharge limitations were identified in the consent decree.

The existing GWTP combined with the newly installed Pilot Area extraction, vapor treatment and steam generating systems comprise the Thermal Pilot Study facility. Elements of the Thermal Pilot Study facility constructed over the last 12 months include:

- Steam injection and extractions wells.
- Water supply well.
- Subsurface instrumentation.
- Boiler building and tank slabs.
- Underground utilities trenches for electrical power, water lines, and contaminated fluid conveyance piping.
- Vapor cap and vapor collection piping within the Pilot Study Area.
- Improvements in the site's electrical service.
- Installation of the steam generation and injection system.
- Installation of the water and vapor extraction system.
- Modifications to the existing groundwater treatment and processing systems including replacement of the existing depurator with a new Dissolved Air Flotation (DAF) system.
- Above ground mechanical and boiler equipment installation.
- Installation of a fuel storage and supply system.
- Installation of the water supply well pump and associated piping.

The existing GWTP at the Wyckoff Facility processes groundwater contaminated with elevated levels of PCP and PAHs. The groundwater is obtained from eight active extraction wells located within the Wyckoff facility boundary outside the Pilot Study Area and seven thermal extraction wells within the Pilot Study Area. In addition to recovering groundwater, the extraction well recovery system outside the Pilot Study Area is designed to recover nonaqueous phase liquid (NAPL) composed of both light nonaqueous phase liquid (LNAPL) and dense nonaqueous phase liquid (DNAPL) in almost pure product form. The thermal extraction wells within the Pilot Study Area recover a mixture of contaminated groundwater, NAPL and contaminated vapors.

1.4 CONSTRUCTION PHASE INVESTIGATION

Installation of the thermal remediation system within the Pilot Study treatment area provided an opportunity for baseline conditions to be assessed prior to steam injection. Extensive sampling during the drilling of extraction and instrument wells was conducted to enable the extent of contaminated soil and NAPL to be determined with exacting precision and accuracy. A detailed description of the baseline investigation activity is provided in the *Work Plan for Thermal Remediation Pilot Study Project, Phase I* (USACE, 2001) and the *Draft Thermal Remediation Pilot Study Baseline Investigation Field Report* (USACE, 2002). This robust delineation will provide greater flexibility during the Performance Assessment phase (Phase III) of the project and enable EPA to determine how successful the Pilot Study was in meeting the performance expectations. If the Pilot Study is successful in meeting the performance objectives, the expanded delineation will also allow for an assessment of operational procedures that optimized NAPL recovery and soil remediation. These lessons will have direct utility during full-scale operations.

During the Construction Phase Investigation, the Region 10 FASP Team mobilized to the site and collected continuous samples at the location of each of the planned 14 extraction and 64 instrument wells using the Region 10 Geoprobe 5400 and a rental GeoProbe 6600 provided by USACE. In an effort to reduce the number of total samples collected and analyzed, potential sample collection during the installation of the injection wells was not included. Previous experience at thermal remediation sites indicates that subsurface zones that receive increased volumes of steam have the greatest probability of meeting remediation goals. It is assumed that soil in the immediate vicinity of injection wells will receive the most steam during active remediation and will most likely meet performance expectations. Consequently, a more complete evaluation of the effectiveness of thermal remediation will be made at locations further away from the location of steam injection represented by the instrument and extraction wells.

Figure 1-1
Locations of Operable Units at Wyckoff/Eagle Harbor Superfund Site

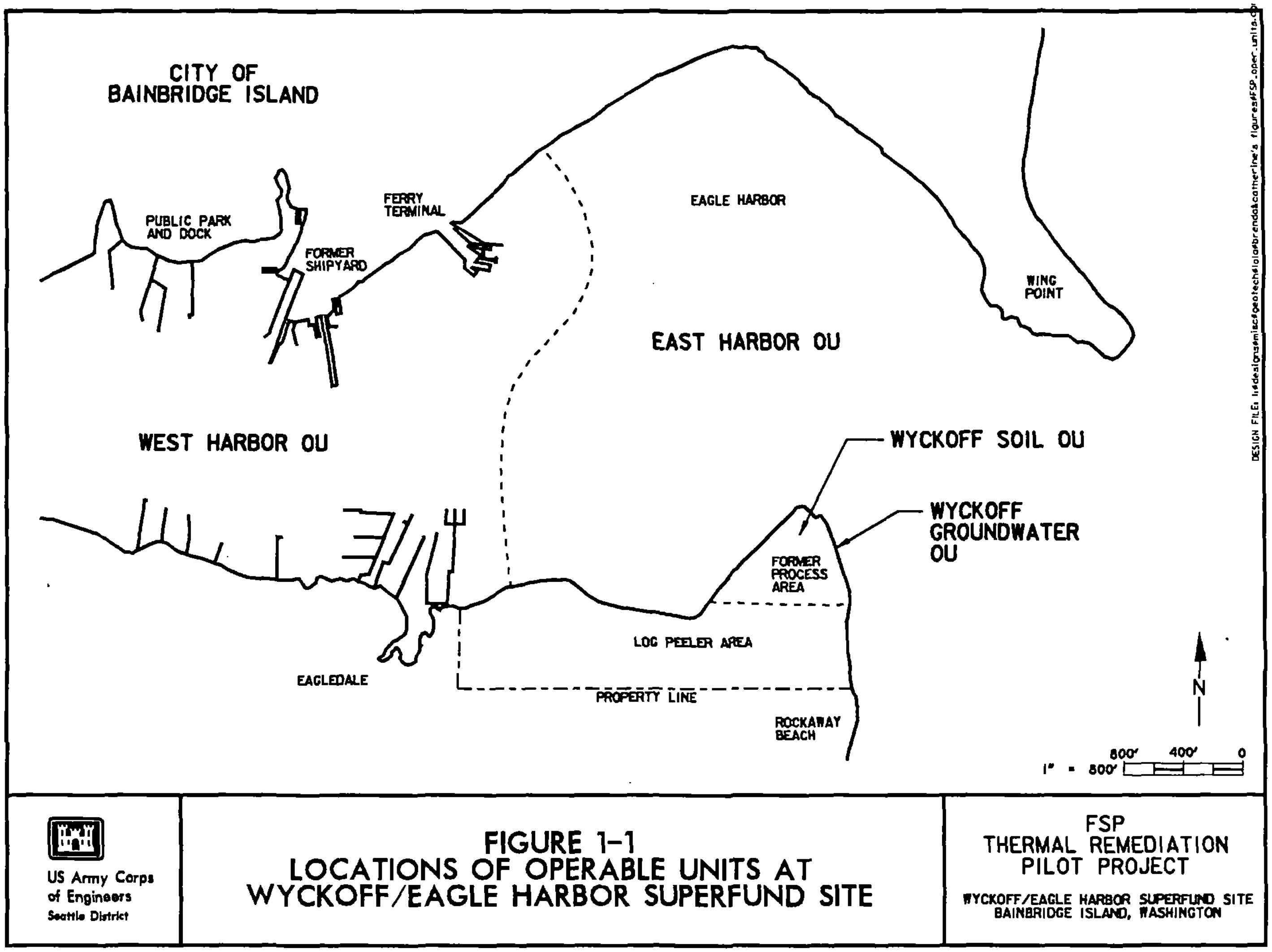
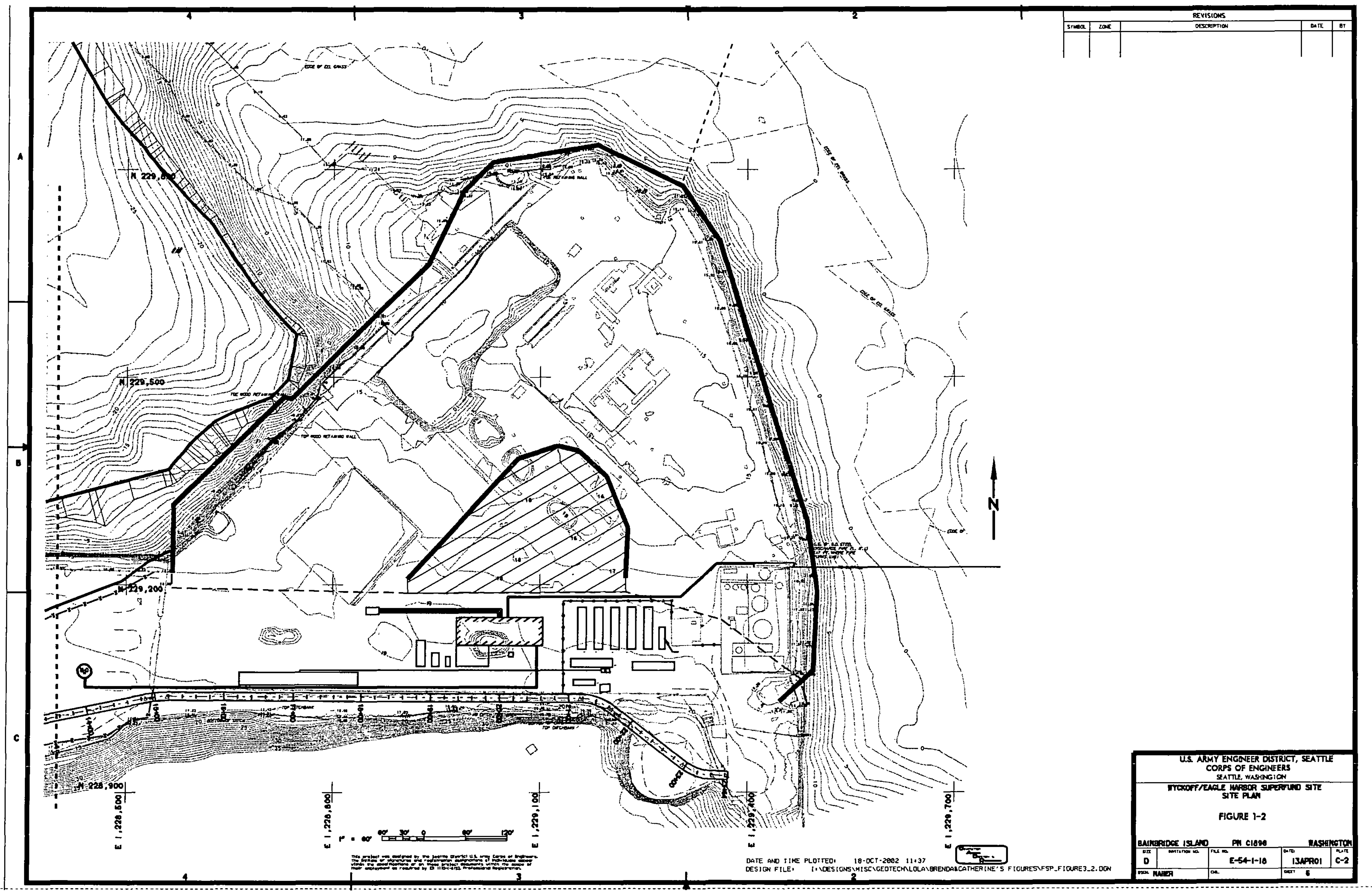


Figure 1-2
Site Infrastructure Support



2.0 PROCESS MONITORING

Extensive data collection will be performed throughout the duration of the Pilot Study in order to evaluate the system's effectiveness in meeting the nine project objectives presented in Section 1.1. Data will be collected from the following site areas or systems:

- Pilot study area. Temperature, pressure, and flow will be monitored in the subsurface to track the movement of heat throughout the treatment area.
- Steam generation system. Rate and mass of steam production from the boiler into the wells will be monitored to support heat flux calculations.
- Groundwater treatment plant. Water samples will be collected from selected sampling points within the GWTP to monitor performance and optimize operations. Effluent discharge samples will be collected from the GWTP to demonstrate compliance with substantive requirements of the NPDES permit and 1988 Consent Decree.
- Upper and lower aquifer groundwater. Groundwater samples will be collected from groundwater wells and extraction wells to evaluate the effectiveness of the thermal treatment system and to evaluate potential for off-site migration of NAPL or contaminants of concern.
- Site perimeter. Noise, air quality, intertidal conditions, boiler air emissions and sheet pile wall integrity will be monitored to evaluate the potential impacts of full-scale thermal treatment to the surrounding community and the near shore marine habitats.
- Waste disposal. Waste characterization samples will be collected for all materials requiring off-site disposal.

The general procedures to be used during these data collection efforts are described in the following sections.

2.1 PILOT AREA PROCESS MONITORING

The fundamental process used in thermal remediation is to add thermal energy in the form of steam to the subsurface to aid in the recovery of NAPL and contribute to the actual destruction of NAPL constituents in the upper aquifer. Destruction of contaminants occurs through a combination of physical and chemical processes including enhanced biodegradation and hydrous pyrolysis oxidation (HPO). Not surprisingly, it is important to track the movement of heat throughout the treatment area in order to operate the recovery process effectively. This is particularly true when the objective is to describe and evaluate the extent of conductive and advective heating and or steam front movement through the treatment area.

Success of the thermal pilot study will require careful monitoring of subsurface conditions in order to ensure that each of the performance expectations is achieved. One of the key features of the monitoring program is the collection and interpretation of thermal data within the Pilot Study

Area. A rigorous monitoring program will ensure that the project operations team has sufficient data to operate and optimize the thermal remediation process and evaluate operational approaches, which may impact removal of NAPL. Elements of the process monitoring program include thermal logging, steam and liquid flow monitoring, and pressure monitoring.

The installed Pilot Study design includes 16 steam injection wells, 7 thermal extraction wells, and 64 dedicated instrument strings. Each of the wells contains some thermal monitoring capability. Data from these instruments will be used to maintain a total heat budget for the Pilot Study. The location of the wells and monitoring points are shown on Figure 2-1.

2.1.1 Subsurface Thermal Monitoring

Thermal monitoring in the subsurface provides data for the evaluation of heating effectiveness and helps determine the location and direction of steam fronts. When combined with wellhead extraction and flow data, thermal monitoring will also help evaluate heat flow patterns and identify areas requiring focused thermal treatment.

There are a total of 637 individual monitoring points in the injection and extraction wells and the temperature strings. Thermocouples will be used to monitor at 467 points, and the remaining 167 points will be monitored with a fiber optic distributed temperature system (DTS). The DTS consists of a continuous loop of specially coated optical fiber installed inside a ¼" O.D. tubing which is grouted and backfilled in place. The ends of the optical fiber are connected to an opto-electronic readout unit on the surface. Temperature is measured by sending a pulse of light down the optical fiber causing molecular vibration, which is directly related to temperature. The molecular vibration creates a weak reflected signal detected by the read-out unit at the surface that is converted to values of temperature at one-meter intervals along the entire length of the fiber. A thermocouple string was installed along with the DTS fiber in one location (Instrument String T-7), in order to verify the DTS accuracy, reliability, and calibration.

The thermocouples used for the subsurface monitoring of temperatures are type E. Type E thermocouples were selected because they produce a higher voltage per degree output (better resolution) and are believed to be more repeatable in thermal cycling over the anticipated temperature range. The two metals used in type E are Constantan and Chromel. The other two standard types, J and T, were not considered because they use iron and copper conductors respectively and are thus more susceptible to corrosion. Typical monitoring well details are shown on Figure 2-2.

2.1.1.1 Injection Wells

Three thermocouples are located in each injection well: at the top, middle, and bottom of the screen for a total of 21 thermocouples. The thermocouples were backfilled and grouted in the annular space between the drill casing and the steam injection casing. The position of the thermocouples will assist the operations team in verifying the vertical distribution of steam and confirm that steam is injected at the bottom of the screen and not just the upper portion.

2.1.1.2 Extraction Wells

The thermal extraction wells will be monitored with the DTS. The fiber was grouted and backfilled in the annular space between the drill casing and the screened extraction riser. The required vertical spacing is 1.5 meters, however the DTS has a one-meter resolution. Therefore, the bottom of the DTS fiber is 1.5 meters beneath the aquitard surface.

Temperature measurement at the thermal extraction wells will be used to develop steam breakthrough curves to determine liquid extraction rate adjustments. The placement of DTS temperature measurement points below the top of the aquitard will allow the operations team to confirm that steam is sweeping along the top of the confining layer and increasing the effectiveness of NAPL removal along the interface between the upper aquifer and the aquitard.

Temperature will also be measured at the wellhead to assist the operations team in evaluating steam breakthrough during pressure cycling. Extracted liquid temperature is also an important parameter for the calculation of heat lost from the system and will be used to document enthalpy.

2.1.1.3 Instrument Strings

Soil temperature will be monitored in vertical instrument strings in 64 locations. Fifty-four of the instrument strings will be monitored with thermocouples and 10 with DTS. The bottom sensor or fiber is located at the top of the aquitard. Maximum spacing for the thermocouples is 1.5 meters with an additional monitoring point placed mid-way between the lowest thermocouple and 1.5 meters above the top of the aquitard. The uppermost measurement point is in the middle of the collection layer of the vapor cap.

These dedicated instrument strings will allow the operations team to document balanced heating in the treatment area. The horizontal and vertical spacing of temperature data within the Pilot Study Area is required to identify that potential problem areas receive adequate steam. Combined with a measurement accuracy of $< 2°$ C, the operations team will be able to identify areas being heated by hot water rather than steam and adjust injection rates at individual wells to balance steam flow through the subsurface. The tight spatial distribution of monitoring points measured on a daily frequency will enable the operations team to evaluate pressure cycle frequency and duration to optimize contaminant recovery.

Subsurface temperature monitoring will also assist the operations team in predicting fuel usage as the project progresses and is required to calculate the total enthalpy of the subsurface for energy balance calculations. These calculations will also assist EPA in the final assessment of the Pilot by providing data for estimating the total number of pore volumes of steam injected into the treatment area. The performance assessment, which focuses on evaluating how well the Pilot Study has met the performance objectives established in the ROD, relies on an estimate of injected steam pore volumes. Energy balance calculations will be vital in determining the cost effectiveness of thermal remediation technology at the Wyckoff site.

2.1.2 Pressure Monitoring

There are a total of 62 pressure monitoring points within the Pilot Study Area. Forty-six of the pressure measurements are located above the cap surface on the steam injection and thermal extraction well heads (two per well). Each pressure gauge will have a unique identifier in the following format:

AA-B-CC##D

Where:

AA = type of data point (PG = Pressure Gauge, TG = Temperature Gauge, TC = Thermocouple, VP = Valve Position, SC=Pump Stroke Counter, FM = Flow Meter, SP = Liquid Sample Port, etc.)

B = Type of media being monitored, (S = Steam, V = Extracted Vapor, L = Extracted Liquid)

CC = Associated well type or other location (IW= Injection Well, EW = Extraction well, SL = Main Steam Line, VL = Main Vapor Line, CL = Main Condensate Line, etc.)

= Unique well or location identifier number

D = Location with respect to the well head where two gauges are located on either side of a control valve. (A = Closest to the well, B = farthest from the well)

For example "PG-S-IW04A" is the pressure gauge (PG) for steam on injection well 04 (IW04) that is closest to the well head (A)

Pressure gauges will be read once, at about the same time, each day. Pressure and Time will be recorded on the Daily Pilot Area Data Log form and transferred to the computerized database for preparing time-series graphs of pressure over time for each monitored location.

In addition, 16 pressure transducers have been installed in the subsurface within the Pilot Study Area. Seven of these instruments were installed at the bottom of each thermal extraction well and nine are located in instrument strings distributed across the Pilot Study Area.

2.1.2.1 Injection Wells

The pressure in the steam line will be monitored daily near each of the sixteen injection wells while steam in being injected. Pressure across each flow control valve will be read manually at 32 gauges installed on either side of each valve by the O&M personnel and recorded on the Daily Pilot Area Data Log. Pressure measurements will be used to verify flow measurements and prevent damage to the well and conveyance system.

2.1.2.2 *Extraction Wells*

The pressure in the vapor extraction line will be monitored daily near each of the seven extraction wells when the vapor extraction system is being operated. Pressure across each flow control valve will be read manually at 14 gauges installed on either side of each valve by the O&M personnel and recorded on the Daily Pilot Area Data Log.

At the wellhead, pressure data will be used by the operations team to document the vacuum in the system and the change in pressure during pressure cycling for a discussion of pressure cycling).

A vibrating wire pressure transducer has also been installed down-hole, at ½ meter below the aquitard surface. The transducer is grouted in with the DTS fiber. These down-hole instruments enable water levels to be determined during thermal treatment. Accurate water level data is important to control the liquid phase extraction rate and assists in documenting hydraulic control of the treatment area. When combined with contaminant extraction data, water level data will support operation decision-making by confirming if NAPL migration is encouraged during limited draw down conditions.

Installation of the vibrating wire transducer within grout at the bottom of the thermal extraction wells and selected instrument strings allows accurate water level measurements without silting or other failures documented in previous thermal projects. The selected transducers are capable of responding to a 1 psi change in pressure measured by an inflow of 2 x10^{-5}ml of water. This volume of water is available within the grouted flow path between the formation and the tip of the instrument. Since the transducer is secured within grout, it is protected from silting or physical displacement that may occur during steam injection and measurements will not be impacted by the flow of liquids in the formation.

2.1.2.3 *Instrument Strings*

A vibrating wire pressure transducer has been grouted in at the top of the aquitard in nine of the instrument strings (T12A, T14A, T22A, T25A, T27A, T29A, T40A, T46A, and T63A) shown in Figure 2-1. These pressure measurements will augment the data from down-hole transducers in the extraction wells to document hydraulic control of the treatment area.

2.1.3 Flow Monitoring

Flow will be monitored daily in the steam injection line and vapor extraction lines (see above) at the wellhead. Steam and vapor flow rates will be used by the operations team to maintain energy balance calculations and identify wells requiring service. At the steam injection and vapor extraction wells, steam and vapor flow rate will be calculated based on the position of the control valves and pressure drop across the valve. The control valve position will be recorded on the Daily Pilot Area Data Log on days during steam injection or vapor extraction. Vapor flow will also be recorded directly from a flow meter (FM-V-E04) installed at Extraction Well E4. Vapor flow will also be recorded from flow meters on the vapor main (FM-V-VL01) and upstream of the non-condensable vapor treatment system (FM-V-VL02).

Flow will also be monitored in the liquid extraction line by using the stroke counter installed on each of the thermal extraction pumps. The QED Hammerhead pumps installed in the thermal extraction wells pump 0.8 gallons per stroke. By recording the number of strokes per unit of time, a flow rate can be determined for each well. These readings will be collected electronically and plotted daily by the USACE data collection system (See Section 2.1.4).

Flow data from the liquid extraction wellheads will be used by the operations team to evaluate the function of down-hole pumps and determine the frequency of maintenance. In addition, this data will be used to document the water balance across the treatment area. When combined with wellhead chemical data, liquid flow data will enable the operations team to track the mass balance of contaminants recovered from each well and evaluate strategies for the optimization of contaminant recovery during pressure cycling.

2.1.4 Subsurface Data Collection and Management

Two USACE operated and maintained electronic data collection systems will be used to collect and process data from the field instruments. Data from the DTS readout unit will be collected and stored on a portable on-site personnel computer (PC) in binary format and converted to ASCII format. All thermocouples, vibrating wire pressure transducers and flow meters will produce 4-20 mA output that will be monitored by a Supervisory Control and Data Acquisition (SCADA) system. The components of the SCADA system include a PC (the same PC used with the DTS system), remote terminal units (RTU) and input/output (I/O) modules. A SCADA system is a host driven data collection system. Data from the RTUs and I/O modules is only sent to the PC in response to a poll from the PC. Software running on the PC will be used to program the required reading schedules and to reduce the raw data to engineering values.

The RTU is a base controller unit providing a Modbus compatible communication port. Seven RTUs will be distributed around the site in NEAM 4 enclosures, each capable of connecting to as many as 60 I/O modules. One module will be required for each vibrating wire and 4-20 mA sensor. Two thermocouples can be connected to a single module. The NEAM 4 enclosures for both the RTUs and the I/O modules will either be mounted on a 4x4 wooden post or to the side of the pipe supports.

Communication from the PC to the RTUs will occur over an opto-isolated RS485 wireline digital link. The communication between an RTU and its modules will occur over a 4-conductor bus extension cable that will carry both data and power. These connections will also be opto-isolated. The opto-isolation of all field communication connections will provide sufficient surge protection. Data from the SCADA system will be stored in a SQL database on the PC. A query will extract and format data from the database and store the data in the same format used for the DTS ASCII files.

Data from the instrumentation system will be collected daily via modem by Seattle District and on-site contractor staff. Data will subsequently be plotted using off-the-shelf graphics and data visualization software and posted to a web site for review. Temperature, flow and pressure data will also be entered into dedicated spreadsheets for use in reporting total enthalpy and other operational parameters for use by the operations team.

2.1.5 Contaminant Removal and Recovery

2.1.5.1 Extracted Liquid and Vapor Removal and Analysis

As discussed in Section 2.1.3 (Flow Monitoring), the flow of liquid and vapor will be measured at each extraction well to provide data for mass balance calculations and for use by the operations team for process control. The extraction well influent streams (liquid and condensed vapor) will be combined prior to entering the treatment plant. Total Organic Carbon (TOC) concentrations will be measured at this junction to provide a measurement of total hydrocarbon extracted. This data will be used for mass balance calculations and to aid the process operations team in identifying variations in recovery efficiency. TOC will be monitored continuously with an in-line Shimadzu TOC analyzer (Model TOC-4000). The in-line TOC instrument uses the established 680°C catalytically aided combustion technique to determine the total organic carbon content of samples representing the liquid waster stream from the Pilot Study Area. Measurements will be made three times per hour and averaged over a 24 hour period for posting to the project web site. Standard operation of the instrument allows measurement from 0-1000 ppm total carbon. An integrated dilution function allows measurements up to 20,000 ppm. If required by the operations team, the measurements for an entire day can be retrieved and evaluated.

Analytical samples will also be collected from the thermal extraction wellhead sampling ports (SP-L-EW01 – SP-L-EW07) to further delineate the composition of the contaminants recovered from the Pilot Study Area during thermal operations. Up to 14 samples will be collected each day and visually examined for NAPL content. Representative samples will be shipped to the project CLP laboratory for analysis of PAHs and PCP. The Site Manager will select samples for analysis after consultation with the operations team. Emphasis will be placed on closely monitoring the array surrounding thermal extraction well E-4. This array is the largest, is generally more representative of conditions site-wide and has enhanced flow instrumentation installed. Other parameters that will be used to select samples to be analyzed include soil temperature, flow rates, steam injection rates and visual inspection of extraction well effluent.

2.1.5.2 Condensate Production Rate and Non-Condensable Flow Rate

The vapor streams from individual extraction wells will be combined in the conveyance system and pass through a condenser prior to reaching the treatment plant. After the condenser, two flow rates will be recorded daily during vapor extraction activity. One flow rate measured will be the total condensate production, and will be measured by a standard industry meter (FM-L-CL01). The second flow rate is of the non-condensable gases passing through the condenser (FM-V-VL02). These two flow rates are used in support of overall mass balance and heat flux calculations.

2.1.5.3 Condenser Temperature Monitoring

The temperature drop across the condenser is also measured daily during vapor extraction activity and is complementary to the flow rate, mass balance and heat flux calculations.

Additionally, the temperature drop monitoring is necessary for process control of the condenser and is also helpful in monitoring the condenser effectiveness.

2.1.5.4 Non-Condensable Gases Stream Analysis

The non-condensable gases will be collected and analyzed weekly for PAH, PCP, total hydrocarbons, CO2 and O2 to determine the constituent concentrations before going to the boiler or the thermal oxidizer for destruction. Carbon dioxide is the significant parameter for determining mass balance calculations and provides data to evaluate the extent of the biologically enhanced degradation of contaminants.

A sampling port will be installed in the boiler building between the heat exchangers and the vapor treatment system.

Samples will be collected on a weekly basis onto polyurethane foam or XAD2 cartridges for PAHs and PCP analysis. The sample containers will be removed from the composite sampler on a weekly basis for shipment to an offsite laboratory. In addition, the vapor stream will be sampled using Tedlar bags for analysis of oxygen and carbon dioxide. The sampling location, test parameters analytical methods and monitoring frequency are summarized in Table 2-1.

All non-condensable gas samples will be identified on chain-of-custody forms, analysis requests, and sample tags with EPA-assigned sample numbers, RAS case numbers (if applicable), and sampling location IDs (e.g., NCG-1). Specific sample containers and sample handling requirements for non-condensable gas samples are described in Table 2-2.

2.1.5.5 Volumetric Measurement of NAPL

The Dissolved Air Flotation (DAF) unit will be the primary NAPL recovery process in the treatment plant for liquids recovered from the Pilot Study Area. NAPL recovered from the extraction wells outside the Pilot Study Area will be recovered separately at the wellhead. The volume of product recovered by the DAF will be determined by pumping recovered NAPL to the product storage tank, T-105, with a volume of 10,150 gallons. The height of the product and water in the tank will be determined using a product/water interface probe. The tank volume will be measured daily during the pilot study to provide an average daily NAPL recovery rate and support mass balance calculations.

2.1.5.6 Dissolved Oxygen and CO_2 in Extracted Liquid

The dissolved oxygen levels in the extracted well liquid will be measured to indicate the amount of air that should be pumped into the wells to enhance biodegradation and oxidation reactions. These measurements will be made of the liquid influent to the treatment plant at the wellheads. If dissolved oxygen levels are low, the air injection rate may be increased to overcome oxygen consumption. Maintenance of dissolved oxygen levels will allow oxidation reactions to proceed in the subsurface along the entire distance between injection and extraction wells.

Dissolved oxygen and CO_2 will be measured using CHEMetrics colorimetric field test kits (Indigo Carmine-ASTM D 888-87 for Dissolved Oxygen and APHA Standard Methods 19^{th} ed method 4500-CO_2 C (1995) for CO_2). A tube will be connected to the extraction well sample port and a large mouth 200 ml sample jar will be slowly filled from the bottom up with extracted liquid following procedures outlined in the test kits to avoid aeration of the sample. Tests will be run immediately after the sample is collected. Possible interference from free product, turbidity, or color in the sample will be noted in the sample log.

2.2 STEAM GENERATION SYSTEM PROCESS MONITORING

Total Steam Production

The steam production from the boiler to the wells will be measured to support the heat flux calculations. The steam will be produced in several chambers in the boiler and piped to a main for distribution to the injection wells. Steam flow rate monitoring is discussed in Section 2.1.3. Steam production data will be recorded in the Steam Plant Daily Log.

2.3 GWTP PROCESS MONITORING

The process monitoring that will be conducted during the Thermal Remediation Pilot Study in the GWTP includes the following subcategories:

- Monitoring to evaluate GWTP performance during the Pilot Study to allow optimization of operations
- Monitoring to demonstrate compliance with substantive requirements of the NPDES permit and 1988 Consent Decree

2.3.1 Process Monitoring

Water samples will be collected weekly from selected sampling points within the GWTP. The number of sampling points may decrease in time but might also increase by three to eight points if additional treatment procedures are incorporated or if the treatment train changes. Samples will be analyzed for polynuclear aromatic hydrocarbons (PAHs), pentachlorophenol (PCP), and several general chemical and physical parameters. Analyses will be performed by operators at the onsite GWTP laboratory or by the EPA Region 10 Laboratory located in Manchester, Washington. All laboratories will adhere to the specifications of the QAPP, as well as to all agency requirements.

2.3.2 Compliance Monitoring

Effluent discharge monitoring from the groundwater treatment plant will be modified from the current sampling frequency during the early stages of the pilot study. Initially, effluent will be sampled and analyzed for chemical parameters under the existing permit with the addition of temperature, and dissolved oxygen. For the first three months of thermal operations, sampling frequency will be:

- Daily effluent sampling during weeks 1 and 2

- Twice weekly sampling for week 2 to 3 months
- Biomonitoring at month 3

Based on the results of the sampling data, the sampling frequency will be adjusted as appropriate after the third month of thermal treatment. Any sampling adjustments made will be no less than once per week for effluent chemistry and quarterly for biological monitoring for the remainder of the pilot study.

Compliance monitoring requirements have been identified through the effluent discharge limitations set forth in the 1988 Consent Decree and, more recently, in the 1991 Order. They are currently in force per the Record of the Decision (ROD) for the Wyckoff/Eagle Harbor Superfund Site, Soil and Groundwater Operable Units, Bainbridge Island, Washington (EPA, February 2000). Changes in compliance monitoring requirements over time are discussed briefly below. Analyses will be performed by EPA's Manchester Laboratory.

2.3.3 Sampling Methods and Procedures

Sampling methods and procedures associated with the Thermal Treatment Pilot and the continued operation of the GWTP are discussed below in the following subsections for process monitoring and compliance monitoring characterization. The sampling methods and procedures discussed include sample collection, field measurements, sample identification, analytical requirements, and sample containers and handling.

2.3.3.1 Process Monitoring Sampling Procedures

GWTP samples for process monitoring will be collected at eight locations as described in Table 2-3. Table 2-3 provides a description of each sampling location. Samples will be collected on Monday of each week (except on holidays, when samples will be collected and shipped on Tuesday). The process monitoring schedule and list of parameters to be analyzed for at each sampling location is presented in Table 2-4.

Sample ports consisting of ball valves are located at every sampling location except for the Aeration Tank, SP-5. At these sampling ports, the valve will be opened and flushed for approximately 30 seconds prior to sampling. Grab samples will then be collected by filling sample jars directly from the valve at the sampling port.

At SP-5, a sample will be collected from the approximate center of the tank under at least 1 foot of water using a plastic container attached to an extension pole. The container will be rinsed before and after sampling with plant water to clean any solids from the container. This sample will be analyzed in house for physical parameters only.

Field Measurements

Field measurements will be conducted at each sampling location or at the onsite laboratory immediately upon sample collection. Field measurements include temperature, pH, and dissolved oxygen. The pH and dissolved oxygen probes will be rinsed using distilled water spray prior to each measurement. Each measuring device will be field calibrated or checked against standards according to the manufacturer's specifications. Temperature will be measured first so that a temperature adjustment may be applied to the measurement of other field parameters, if required. Monitoring probes will be placed in separate jars from sample jars containing GWTP water previously collected for laboratory analysis. Field parameters and calibration measurements will be recorded in the field logbook.

Sample Identification

All process monitoring samples will be identified on chain-of-custody forms, analysis requests, and sample tags with EPA-assigned sample numbers, RAS case numbers (if applicable), and sampling location IDs (e.g., SP-0).

Analytical Requirements

Sample analysis will consist of field measurements and onsite and offsite laboratory analysis. All field measurements plus total suspended solids, volatile suspended solids, chemical oxygen demand (total and soluble), ammonia, and orthophosphate analyses will be performed either at the sampling location or at the onsite laboratory. All other analyses (i.e., PAHs, PCP, and TPH) will be performed at EPA's Manchester Laboratory, or other EPA-approved laboratory.

Sample Containers and Handling

Specific sample containers and sample handling requirements are described in Table 2-5. Sample management, including sample documentation, packaging, and shipping, is described in Section 3.0. Samples will be shipped via overnight courier to outside laboratories. Other sample delivery arrangements may be made if the sampling schedule is altered, such as for holidays when courier service is not available.

2.3.3.2 GWTP Compliance Monitoring Sample Collection

A 24-hour composite sample is required for compliance PAHs, PCP, and total suspended solids analysis. Partially composited samples will be maintained at 4 °C during the 24-hour period. A grab sample is required for total dissolved solids. One field duplicate sample will be collected every 4 weeks. Extra volume for MS/MSDs will be collected once every 4 weeks. MS/MSDs are only collected on PAH and PCP samples.

Grab samples will be collected from sampling location SP-11, which is a sample tap located on the 4-inch-diameter pipe that drains the effluent storage tank, Tank 303. Composite samples will be collected using an automated sampler. Prior to composite sampling, temperature, pH, and dissolved oxygen will be measured at the sampling port. The automated composite sampling unit will be properly programmed to collect 1/8th of the total volume required every 3 hours and 25 minutes for 24 hours. Table 2-6 shows the volumes required for original samples, field duplicates, and MS/MSDs. The sampler will be observed if possible when operators are on duty to ensure it is operating properly. Once composite sampling is complete, individual sample jars will be filled directly from the composite sampling container. Field parameters will be measured again from a separate container, and a grab sample for total dissolved solids shall be collected.

Field Measurements

Field measurements will be conducted either at the sampling location or at the onsite laboratory immediately upon sample collection. Field measurements include temperature, pH, and dissolved oxygen. The pH and dissolved oxygen probes will be rinsed using distilled water spray prior to each measurement. Each measuring device will be field calibrated or checked against standards according to the manufacturer's specifications. Temperature will be measured first so a temperature adjustment can be applied to the measurement of other field parameters, if required. Monitoring probes will be placed in separate jars from sample jars containing GWTP water previously collected for laboratory analysis. Field parameters and calibration measurements will be recorded in the field logbook.

Sample Identification

All compliance monitoring samples will be identified on chain-of-custody forms, analysis requests, and sample tags with EPA-assigned sample numbers, and RAS case numbers (if applicable) and sampling location ID (i.e., SP-11) only. Note that composited samples should be identified with the date compositing was finished, not begun.

Analytical Requirements

All field measurements (i.e., temperature, pH, and dissolved oxygen) will be performed at the onsite laboratory. All other analyses (i.e., PAHs, PCP, total suspended solids, and total dissolved solids) will be performed at EPA's Manchester Laboratory or at an EPA-approved laboratory. Table 2-7 provides a list of compliance monitoring analyses and where they will be performed.

Sample Containers and Handling

Specific sample containers and sample handling requirements are described in Table 2-8. Sample management including sample documentation, packaging, and shipping is described in Section 3.0. Samples will be shipped via overnight courier to offsite laboratories. Other sample delivery arrangements may be made if the sampling schedule is altered, such as for holidays when courier service is not available.

2.3.3.3 Biological Compliance Monitoring

GWTP effluent samples for biomonitoring will be collected every 3 months (four times per year) as specified in Section I.8 of the Interim Groundwater OU ROD. Toxicity testing will be conducted on 24-hour composite samples that are also being tested as part of weekly chemical compliance monitoring. Testing requirements and sampling schedule are shown in Table 2-9.

Sample Collection

GWTP final effluent samples for biomonitoring will be collected using an automated composite sampler that is connected to the 4-inch-diameter steel pipe that drains the final effluent tank (T-

303). The capacity of the automated sampler container is 5 gallons. The total volume of sample required for biomonitoring is as much as 7.5 gallons. An additional 5 gallons will be required for split samples that will be collected for chemical compliance monitoring (refer to previous subsection). Therefore, the automated sampler will be programmed to collect 5 gallons during an 8-hour period, so that an accumulated volume of 15 gallons will have been collected over a 24-hour period. Each sample container (for both biomonitoring and chemical analyses) will be filled to 1/3 of the total volume from each 5-gallon composite sample.

Field Measurements

No additional field measurements are necessary for biomonitoring. Field measurements (temperature, pH, and dissolved oxygen) will be conducted as part of the chemical compliance monitoring.

Sample Identification

All biomonitoring samples will be identified on chain-of-custody forms, analysis requests, and sample tags with EPA-assigned sample numbers. Field identifiers will also be assigned to each sample number and will use the following scheme:

SP-##.

Where:

SP—Sampling Point

##—2-digit sampling point number (11 for final effluent)

Analytical Requirements

The following toxicity tests will be performed on final effluent from the Wyckoff GWTP:

- Acute toxicity test for estuarine fish: *Menidia beryllina* (Inland Silversides). This test is performed once per year.

- Chronic toxicity test for bivalve larvae: *Mytilus Sp.* (blue mussel) or *Crassostrea gigas* (Pacific oyster). This test is conducted on a quarterly basis.

The toxicity test specifications are listed in Table 2-10. Quality assurance (QA) protocols, test conditions, duration, dilution series, and reporting requirements are presented in the QAPP.

Sample Containers and Handling

Specific sample containers and sampling handling requirements are presented in Table 2-11. Sample management including sample documentation, packaging, and shipping is described in Section 3.0. Samples will be shipped via overnight courier so that analysis may begin within 36 hours of sampling.

2.4 COMMUNITY AND ENVIRONMENTAL IMPACTS MONITORING

The objective of community and environmental impacts monitoring is to evaluate potential impacts of Pilot Study operations on the surrounding community and near shore marine habitats, and to demonstrate substantive compliance with local, state and federal environmental regulations. In addition, data collected during the Pilot Study will be used to infer possible impacts during full-scale treatment if EPA selects the thermal remedy for site-wide implimentation. Community and environmental impacts monitoring is focused on measuring and evaluating impacts beyond the perimeter of the site.

Groundwater quality, noise, air quality, intertidal conditions, boiler air emissions and sheet pile wall integrity will be monitored to evaluate the potential impacts of full-scale thermal treatment to the surrounding community and the near shore marine habitats.

2.4.1 Groundwater Sampling

Groundwater samples for performance and environmental impacts monitoring will be collected at groundwater well and extraction well locations described in Table 2-12. Samples will be routinely collected from as many as 13 well locations within and outside of the pilot treatment area as directed by the Operations Team. Samples will be collected from the upper and lower aquifers to evaluate the effectiveness of the thermal treatment system and to evaluate the potential for off-site migration of NAPL or contaminants of concern.

The following subsections describe general procedures for the decontamination of field equipment, purging of wells, acquisition of field measurements, groundwater sampling and sample packaging and shipping.

A maximum of seven upper aquifer monitoring/extraction wells will be sampled immediately prior to steam injection and twice upon completion of the pilot treatment (at successive 50% reductions in soil temperature within the thermal treatment area). A maximum of six lower aquifer monitoring wells will also be sampled immediately prior to steam injection. In addition, the lower aquifer wells will be sampled three times during the steam injection period (monthly during the first three months of thermal treatment) and three times (at quarterly intervals) upon completion of the thermal treatment. The list of parameters to be measured at each sampling location is presented in Table 2-13.

Field activities will consist of obtaining field measurements for water level elevation, pH, specific conductance, temperature, and dissolved oxygen, collecting groundwater samples for laboratory analysis, and packaging and shipping the samples to the laboratory.

2.4.1.1 Sample Collection

All groundwater samples collected from upper and lower aquifer monitoring wells will be collected using the low-flow purging methods described in this section. Samples collected from the pilot area extraction wells will be obtained using existing pumps and sample ports. Sample ports consist of ball valves that are fitted directly into the piping connected to each extraction wellhead.

The depth to the water table will be measured to the nearest 0.01 feet in each well that does not have a pump installed in it before commencing well purging and groundwater sampling. Wells without pumps that are not operating will be purged before sampling. Water quality parameters, including specific conductance, pH, dissolved oxygen, and groundwater temperature, will be measured during well purging to ensure the collection of a representative groundwater sample. An accurate record of all sampling activities, field measurements and site observations made during each monitoring event will be maintained in a field log.

All non-disposable equipment that is exposed to well water (specifically the water level probe) will be decontaminated between wells with a three-point wash. Decontamination of equipment will be completed before leaving each well head, therefore, eliminating cross contamination. The wash will consist of:

- Physically removing any visible contaminants from sampling equipment by rinsing with tap water.
- Washing equipment with non-phosphate detergent solution such as Alconox©.
- Rinsing with deionized, contaminant-free water.
- Collecting all liquids generated in decontamination. These liquids may be discharged at the designated decontamination area or at the groundwater treatment plant.

Disposable gloves (latex/nitrile) will be discarded after each use and prior to leaving each well head. All disposable sampling equipment will be properly discarded into dedicated waste collection drums.

Low-flow purging and sampling at the groundwater monitoring wells will be conducted using either a Sample Pro™ bladder pump (QED Environmental Systems, Inc.) or a peristaltic pump. The bladder pump will be used to sample all of the lower aquifer wells. Where the water table is sufficiently shallow, the peristaltic pump will be used to sample the upper aquifer wells to minimize the potential for cross contamination from the significant product accumulations that can be present in these wells.

At each monitoring well, the pump flow will be "set tested" to determine, and document, the specific well's optimum pumping rate (between 100 and 500 ml/min) that would result in achieving a minimal drawdown of the initial static water level (SWL). Once established, this rate will be reproduced for each subsequent sampling event. If a significant change in initial water level occurs between events, it may be necessary to reestablish the optimum flow rate at each sampling event.

Samples from operating extraction wells with pumps in place will be collected from sample ports located on the wellhead pipes. Well purging will not be necessary because the wells will be operating continuously. Stagnant water in the sampling port will be briefly flushed by opening the port and allowing it to drain into a collection container such as a bucket. The sample port will be checked for foreign matter and wiped clean with a gloved hand if any is observed. Sample containers and a container for field parameter testing will be filled directly from the sample port. After collecting the sample, the sample port will be closed completely and inspected to verify that flow has ceased. The bucket of purge water will be transported to the treatment plant and emptied into the sump for treatment.

2.4.1.2 Field Measurements

For low-flow samples, once the optimum pump flow rate has been established at a well location, and at least one pump system volume (bladder volume + discharge tubing volume) has been purged, field measurements for pH, temperature, conductivity and dissolved oxygen will commence. Purging will continue until indicator parameters have stabilized.

Indicator parameters will be considered stable when three consecutive readings fall within the prescribed ranges (discussed below) for the parameters of interest. Rigid numerical criteria for stabilization (as opposed to evaluating the slope of the graphs of the parameters vs. time) can be problematic as the ability of numerical criteria to identify stability is influenced by the accuracy and repeatability of field instruments, flow rate, and duration between measurements. The frequency of readings will therefore be based on the time required to purge one volume of the flow cell. For example, a 500-ml flow cell purged at a rate of 250 ml/minute will be purged in two minutes, so readings should be at least two minutes apart. If the flow rate is 100 ml/min, the readings should be at least 5 minutes apart, etc.

To account for the accuracy and repeatability of field instruments, indicator parameters and the ranges for stabilized values are as follows:

- Temperature: + 0.5° C
- pH: + 0.2 units
- Conductance: + 5.0 % of reading
- Dissolved oxygen: + 0.2 mg/L

When water quality parameters have stabilized, and there has been no change in the pumping water level (i.e. no continuous drawdown), sample collection may begin. All field instruments will be calibrated in accordance with manufacturer's guidelines.

2.4.1.3 Sample Identification

All groundwater monitoring samples will be identified on chain-of-custody forms, analysis requests, and sample tags with EPA-assigned sample numbers, RAS case numbers (if applicable), and sampling location IDs (e.g., CW-15).

2.4.1.4 Analytical Requirements

Sample analysis will consist of field measurements and offsite laboratory analysis. As listed in Table 2-13, general water quality and inorganics analyses (alkalinity, TOC, nitrate, nitrite, sulfate, sulfide, chloride and total metals) will be performed offsite by SCS Engineers' contractor laboratory. All organic analyses (PAHs/PCP and diesel-range petroleum hydrocarbons) will be performed by the EPA Manchester Laboratory.

2.4.1.5 Sample Containers and Handling

Specific sample containers and sample handling requirements are described in Table 2-14. Sample management, including sample documentation, packaging, and shipping, is described in Section 3.0. Groundwater samples will be properly packaged to prevent accidental breakage and shipped in coolers (with ice) to the offsite laboratories. Chain-of-custody documentation and related EPA sample forms will be included with each shipment.

2.4.2 Noise Monitoring

The substantive requirements related to the impact of the operations on the Wyckoff site on nearby residential areas is described in the Washington Administrative Code (WAC 173-60, Maximum Environmental Noise Levels). The objective of noise level monitoring is to evaluate the impact on the surrounding community during all operational phases of the Pilot Study. Since most of the surrounding area is residential, the Class A receiving noise level of 55 dBA is the regulatory threshold for Pilot Study operations between the hours of 7:00 am to 10:00 pm. During all other times, noise levels at receiving properties cannot exceed 45 dBA.

A background study has been conducted to measure ambient noise conditions at three community monitoring locations. The three monitoring locations included; 1) the Wing Point residential area; 2) the marina directly west of the former Wyckoff facility; and 3) the residential area directly south of the former Wyckoff facility. Since ambient background noise levels have been established, four monitoring events shall be conducted during the first six months of planned steam injection activity at the site. Noise levels will be monitored concurrently at the three community monitoring locations during each monitoring event. Each monitoring event will be conducted over a 48 hour period while the facility is operational.

Monitoring events will utilize Type I or Type II sound level meters with demonstrated accuracy of ± 1 dBA for Type I meters and ± 2 dBA for Type II meters. At the time of testing, wind speed will not exceed 12 mph and no testing will occur when precipitation is falling at a rate that will affect measurement readings. During the test, the microphone used must be oriented in the direction of the Wyckoff facility.

Technically, noise generated by construction activity is exempt from noise regulations. At the discretion of EPA, noise monitoring can be instituted during Pilot Study construction to address specific concerns of stakeholders or the surrounding community.

2.4.3 Air Quality Monitoring

The objective of air quality monitoring is to assure that organic vapors emitted during pilot study operations will not affect the surrounding community or on-site personnel and to demonstrate substantive compliance with local, state and federal air regulations. Conceptually, there are three potential sources of fugitive air emissions: the conveyance system from the wellheads to the treatment plan, the treatment plant, and the soil area surrounding the Pilot Study Area. Since the conveyance system will operate under negative pressure, it is unlikely that the pipe runs from the wellheads to the treatment plant will be a source of organic vapors. Within the treatment plant, the most likely source of fugitive emissions is the Dissolved Air Flotation unit (DAF) and the activated sludge aeration basin. The DAF unit of the current treatment plant has previously been identified as a source of organic vapors at concentrations high enough to require respiratory protection during certain maintenance operations (CH2M HILL 1995). Analytes of concern include PAHs and PCP.

2.4.3.1 Ambient Air Monitoring

During operations, air-monitoring instruments will be placed at stationary locations (to be determined) surrounding the GWTP. Analytes for operation monitoring include PCP and PAHs. Monitoring parameters and sampling frequency are summarized in Table 2-15.

Baseline conditions will be measured during the first week of operations. Particulate matter will be monitored at 4 stations using a Realtime Aerosol Monitor (RAM) every 8 hours for the first seven days of operation. If any 8 hour measurement exceeds $50\mu g/m^3$ in 8 hrs then a RAM will be co-located with a Hi-Vol Sampler or equivalent to determine if the concentration exceeds $150\mu g/m^3$ over 24 hours. If this value is exceeded, institutional controls will be implemented until concentrations decrease below exposure limits. PCP and PAHs will be monitored with a canister sampler and samples sent for laboratory analysis. Samples for all of the organics will be taken every 8 hours for the first seven days of operation. If no PELs are exceeded, the sampling frequency will be decreased. PELs are listed in Table 2-15.

During thermal operations, two ambient air quality monitoring events will be performed. For each event, air-monitoring instruments will be placed at two locations (to be determined based on the forecasted/current wind direction) surrounding the treatment plant area. One monitoring instrument will be placed downwind of the facility and the other will be located upwind of the facility. Analytes measured during operational monitoring of the treatment plant will be PCP and PAHs. Sampling will be performed using a Hi Vol Sampler with XAD-2 resin cartridge or equivalent sorbent (T013A/TO4A). Two sampling events with an option for one additional event correlated to temperature increases in the Thermal Pilot treatment area will be conducted. The USACE will specify the timing of the events and will provide at least two weeks prior notice to the contractor.

2.4.3.2 Onsite Worker Safety Air Monitoring

SCS Engineers will perform worker safety air monitoring during the operational phases of the thermal pilot study. Air quality data from the sampling effort at the facility will be used to characterize worker exposure to airborne chemicals, and to evaluate whether additional worker safety precautions are necessary.

Sample Collection

Onsite air samples will be collected for total suspended airborne chemicals (PCP and PAHs, including naphthalene). Different sampling media will be used for the two analytes to allow for proper sampling and analysis of the target chemicals. All samples will be collected using methods prescribed by the Occupational Safety and Health Administration (OSHA). Samples for PCP analysis will be collected as described in OSHA Method 39, and samples for PAH analysis will be collected as described in OSHA Method 58. Samples collected will be shipped to a certified laboratory for analysis.

Two onsite air samples for each analyte will be collected from each of three designated workstations, along with one blank sample for QA/QC. Two samples provide a minimum level of quality control checks for sampling equipment function and placement, laboratory consistency, and other variables. The blank sample is necessary for the laboratory to calculate the true sample concentration against any background concentration in the sorbent medium. Although the chemicals will be evaluated at more than one location, only one blank QA/QC sample is required per analyte for each laboratory submittal.

Onsite air samples will be collected at three locations where worker exposure to creosote vapors is expected to be most significant. The locations are presented below in Table 2-16.

Samples will be collected at start-up of the steam-injection system and again once operation is underway.

Area sampling, as opposed to personnel sampling, is expected to give worst-case results. If the initial (start-up) results indicate that workers could exceed the PEL, personnel monitoring will be undertaken for sampling during the operational phase.

Particulars of the sample collection methods are presented in Table 2-17. For complete details, refer to the named OSHA methods.

Field Measurements

Prior to air sampling, SCS will conduct a walk-through of the site with a photo-ionization detector (PID) to check for the presence of organic vapors related to creosote product. It is possible that certain workstations or locations will provide a greater indication of organic vapors and a greater potential for worker exposure than the three locations described in this plan. If that is the case, SCS Engineers will relocate the sampling locations based on field measurements and the professional judgment of the air sampling technician.

Field sampling forms will be completed describing the sample name, location, sampling duration, and air-flow rate.

Sample Identification

All of the air samples will be identified on chain-of-custody forms, analysis requests, and sample tags with EPA-assigned sample numbers, and RAS case numbers (if applicable) and sampling location ID (i.e., DAF-1A). Sample location identifications are provided in Table 2-18.

2.4.4 Intertidal Area Thermal Effects Study (TES)

Possible effects of full-scale thermal remediation are of concern in intertidal and shallow subtidal areas in Eagle Harbor and Puget Sound. The intertidal habitat surrounding the Wyckoff site is considered a sensitive area and the potential heat and disturbance impacts to water and sediments require monitoring. Potential impacts may include migration of heat effects beyond control measures (water or sediment temperature may increase some distance from the sheet pile wall), and mobilization of existing NAPL outside of the sheet pile wall. All of these impacts have a reasonable probability of being adequately addressed by control measures. However, Natural Resource Trustees (NRT's) have requested that a study be initiated to determine changes in physical and biological processes in the intertidal area, especially to eelgrass, due to upland thermal remediation. The TES will be performed by Seattle District employees to provide quantitative biological and physical data for deciding whether or not upland remedial activities will impact the intertidal area. Baseline sampling began in April 2000 and was completed in June 2000 to document existing biological conditions in the intertidal area adjacent to the Wyckoff facility and at a reference area in Eagle Harbor.

Thermal monitoring will be conducted outside the perimeter of the Pilot Study Area at three locations to evaluate the extent of heating beyond the perimeter of the Pilot Study Area. These empirical results will be used to calibrate the 2-D Shoreline Model (USACE 2000b) to confirm the expected conduction of heat beyond the active treatment area. If heating outside the active treatment zone is greater than predicted by the existing model, the Thermal Effects Study Management Plan (USACE 1999) will be implemented to conduct a more compete evaluation of conditions in the intertidal area during full scale thermal remediation.

2.4.5 Boiler Air Emission

The objective of evaluating and monitoring boiler emissions is to demonstrate substantive compliance with local, state and federal regulations and demonstrate that the thermal Pilot Study will not affect the ambient air quality in the surrounding community. All calculations are based on the boiler's annual total maximum potential to emit (PTE--boiler running at 100% capacity, full time). Regulatory compliance calculations are based upon manufacturer's emission factors for full-time nominal operations without the non-condensable waste stream running through the system. Further study and analysis will be necessary after the waste stream is introduced into the system.

For combustion emissions without the waste stream, the boiler is expected to be in compliance for all state and federal regulations for emission values, performance standards, and ambient air quality standards (Table 2-19).

The boiler's PTE puts it in the minor source category for the criteria air pollutants (< 100 tons/year for any constituent). However, due to the use of fuel oil the PTE is relatively high for sulfur oxides as compared to natural gas fired boilers of the same capacity. Reasonably Available Control Technology has been considered but will not be installed until information about the waste stream emissions is available since the known control technology has the potential to increase the production of dioxins and furans. The presence of sulfur in the emission stream has the potential to reduce dioxin and furan production, providing a safer, more acceptable emission stream.

Although it is possible to estimate the composition and volume of non-condensable vapors entering the boiler, it is difficult to estimate the quantity or variability of the constituents over time. Therefore, it is not possible to conclusively pre-determine the type or amount of hazardous emissions caused by the waste stream. Toxic Air Pollutants (TAPs) emissions will be monitored to determine the type and quantity produced by the system. Monitoring will occur for the period necessary to demonstrate compliance and shall cover the broadest range of operational conditions. The information will then be compared to state and federal regulations to assure compliance.

Stack test monitoring will include:

- Dioxins and furans
- Total Hydrocarbons
- Volatile Organics
- Semivolatile Organics
- Polycyclic Aromatic Hydrocarbons
- Hydrogen chloride and chlorine
- Particle Size

The specific sampling and analysis procedures for each of the constituents are listed in Table 2-20.

A tiered modeling effort based on these results will be used to demonstrate substantive compliance with the applicable air quality regulations. The first tier of air modeling will involve comparing emission values to de minimis threshold for each TAP. Based on initial estimates of individual contaminant mass flow rates with Washington State Air Toxics de minimis levels listed in WAC 173-465, the untreated non-condensable vapor stream is predicted to fail the de minimis levels for naphthalene, cycloalkanes and monoaromatics. Naphthalene fails to meet the de minimis value by the greatest percentage. It will require a 99.99% treatment efficiency for the estimated naphthalene emissions to meet the de minimis levels.

If the boiler is not predicted to achieve the treatment efficiency for naphthalene, it is necessary to perform a Tier 2 evaluation, which calls for using the SCREEN3 air model to predict discharge concentrations at a nearby compliance point. The SCREEN3 results will be compared against Acceptable Service Input Limits (ASILS), which are listed in WAC 173-465. If the model predicts that the ASILS will be met, then the treatment system will demonstrate compliance with the applicable air emissions requirements.

If the SCREEN3 model results are greater than the ASILS, then a Tier 3 evaluation will be performed using a more rigorous air model that requires site-specific input data (local meteorological data, site topography, etc). The output from this model will then be compared against the ASILS.

If the model predicts that the ASILS will still not be met, then air emission control equipment will need to be designed to meet the ASILS or a waiver from the applicable ARARs will be needed from the EPA Regional Administrator to operate in a manner that exceeds the ASILS. Consequently, it will be necessary to monitor boiler vapor input and stack emissions to validate the non-condensable vapor mass flow rates and treatment efficiency.

2.4.6 Meteorological Monitoring

An Oregon Scientific Model WM-918 Weather station will be used to monitor meteorological conditions at the site. Low and High temperature for the previous 24 hours, wind speed, wind direction, barometric pressure, and cumulative precipitation over the previous 24 hours will be recorded at about the same time each day.

2.4.7 Sheet Pile Wall Performance Monitoring

The sheet pile wall may be affected by the high subsurface temperatures achieved during the Pilot Study. The sheet pile wall will be monitored during the pilot study to evaluate potential changes in the wall's structure and potential leakage of contaminants to the surrounding area.

3.1.7.1 Structural Monitoring of the Sheet Pile Barrier

The sheet pile wall may structurally deform or expand as a result of the high site temperatures. Nine settlement monitoring points will be established on the top of the sheet pile wall adjacent to injection wells. A settlement survey will be conducted on a semiannual schedule during the pilot study.

3.1.7.2 Sheet Pile Leakage Monitoring

Monitoring leakage through the unwelded joints in the sheet pile wall will consist of measuring water levels, conducting pumping tests and determining if NAPL is present in the specially installed joint observation wells welded to joints at various locations along the sheet pile wall. The locations of the three joint observation wells (J09, J10, and J11) are shown in Figure 2-3. The objective of the sheet pile wall leakage monitoring is to determine if interlocking joints of the containment wall inhibit the flow of NAPL and contaminated groundwater from the Wyckoff facility towards Eagle Harbor and Puget Sound.

The primary method for evaluating leakage will be by conducting modified pump tests on each of the joint observation wells installed on the sheet pile wall. These tests will consist of measuring the initial water and/or NAPL levels with an interface probe. A pump will then be inserted into the observation well and set to a reasonable pumping rate to obtain a 1-5 foot draw down within the observation well. The pump rate and draw down will be recorded each minute until both readings stabilize for 10 minutes. The recorded pump rate and head differential will then be used to calculate near-steady-state specific capacity for each of the observation wells. The specific capacity can be used to estimate interlock leakage rates for different water-level conditions. If NAPL or substantial groundwater leakage appears to be occurring, water quality monitoring may be conducted to determine the direction of water flow (into or out of the site).

Direction of flow will be inferred by an increased occurrence of oxidation daughter products from within the Pilot Study Area. For example, NAPL or contaminated groundwater leaking from within the Pilot Study cell will likely contain a greater concentration of naphthanols and quinones than contaminated media leaking into the observation well from outside the active treatment area. The three joint observation wells (J09, J10, and J11) will need to be monitored within three months of sheet pile wall installation and after active steam injection. Required sample analyses are summarized in Table 2-21.

2.5 WASTE DISPOSAL CHARACTERIZATION

Sampling will be conducted for some of the waste streams identified below to verify compliance with all applicable state and federal hazardous waste regulations. The reasons for selective sampling are described in each section below. Waste disposal requirements are listed in Table 2-22.

2.5.1 NAPL Disposal Characterization

NAPL disposal includes all recovered product from the treatment plant and extraction at the wells. NAPL will be recovered by the treatment plant's on-site recovery system. Disposal follows RCRA for off-site transport and final destruction via incineration due to previously established waste characterization as F032 and F034 listed waste. Recovered product does not need to be sampled due to known high concentrations of contaminants and the designation as a listed waste.

2.5.2 Dewatered Biosolids/Sludge Disposal Characterization

Sludge consists of spent biomaterials removed from the treatment plant activated sludge bioreactor. Under currently conceived operational scenarios, contaminated groundwater entering the bioreactor will be designated as a listed waste under the contained in rule. However, biological treatment within the bioreactor may eliminate constituents to comply with the Universal Treatment Standards (UTS). Even if monitoring of the bioreactor influent and effluent demonstrates successful treatment to these standards, analysis of the accumulated sludge will be required to determine if the sludge meets the F032 and F034 Land Disposal Restriction treatment standards. Analytes of concern and applicable regulatory thresholds are described in Table 2-23. Frequency of sampling and analysis will be determined when more is known regarding treatment plant performance and operations under Pilot Study conditions.

2.5.3 Spent Carbon Disposal Characterization

The spent activated carbon (SAC) is subject to sampling to determine the proper disposal method. If sampling of effluent from the bioreactor indicates successful treatment of F032 and F034 listed waste "contained in" groundwater, the SAC may be disposed of in a hazardous material landfill if it meets the RCRA LDR for F032 and F034 waste. However, if groundwater effluent from the bioreactor does not meet UTS the SAC must be incinerated at an approved, permitted unit. Consequently, the waste disposal characterization of SAC is a two-tiered process. The first part of the process is to determine if the SAC should be designated as listed waste by contact with contaminated media (effluent from the bioreactor). Second, the SAC will require testing to determine if concentrations meet the requirement of the LDRs for constituents of the listed waste. Constituents and regulatory thresholds are presented in Table 2-23. Frequency of sampling will be determined by the rate of contaminant removal from the Pilot Study area and treatment plant efficiency.

2.5.4 Spent Filter Media Disposal Characterization

The spent filter media (the sand filter) is subject to the same testing and criteria as the SAC.

2.5.5 On-Site Analytical Waste Characterization Disposal

Any on-site analytical wastes generated during the Pilot Study operations will be lab packed for and disposal in accordance to State and Federal regulations. At this time, specific requirements cannot be determined until the full extent of on-site analytical activity is known.

Table 2-1
Non-Condensable Gas Monitoring- Parameters, Analytical Methods and Sampling Schedule

Location	Parameter	Analytical Method	Sampling Frequency
Between the heat exchangers and vapor treatment system	PAHs and PCP	TO-13A/T0-4A and EPA 8270	Once per week (to a maximum of 30 samples)
	CO_2 and O_2	ASTM D1946	
	Total Hydrocarbons (NMOCs)	EPA Method 25 C Modified	

Table 2-2
Sample Handling Requirements for Non-Condensable Gas Monitoring

Analysis	Type of Container	Sample Volume	Sample Preservation	Sample Holding Time
PAHs/PCP/ Total Hydrocarbons	One, 6-liter Summa canister with XAD/PUP Media	6-liter capacity	None	14 days
CO_2 and O_2	Two, 1-liter Tedlar bags	1-liter capacity	None	3 days

Table 2-3
Treatment Plant Monitoring Sample Location Description

Location	Location Number	Sample Location Description
Treatment Plant Influent	SP-0	Downstream of valve manifold; ½-inch PVC pipe with brass ball valve
Equalization Tank (T-401) Effluent	SP-1	Downstream of Pumps 401A/B; ¾-inch bronze ball valve
Oil/Water Separator Effluent	SP-2	No longer sampled
DAF Effluent	SP-3	No longer sampled
T-402 Effluent.	SP-4	West of Tank 402; ½-inch galvanized pipe with ball valve
Aeration Tank	SP-5	Top center of aeration tank; grab
Clarifier Effluent	SP-6	West end of clarification tank; ¾-inch galvanized pipe with ball valve
Multimedia Filter Effluent	SP-8	North end of multi-media filters; ½-inch galvanized pipe with ball valve
Lead Carbon Filter Effluent	SP-9	West of carbon No. 1 tank; ½-inch galvanized pipe with ball valve
Lag Carbon Filter Effluent	SP-10	West of carbon No. 2 tank; ½-inch galvanized pipe with ball valve

Table 2-4
Treatment Plant Performance Monitoring Sampling Schedule
(see note 1)

Location	Sampling Location	Parameter	Analysis Performed at Onsite Laboratory	Analysis Performed at Offsite Laboratory
Treatment Plant Inlet	SP-0	TOC	Daily (Field Instrument)	
Equalization Tank (T-401) Outlet	SP-1	PAH/PCP		Weekly
T-402 Effluent	SP-4	TOC	Daily (Field Instrument)	
		PAH/PCP		Weekly
		Temperature	Daily	
		Mass Flow Rate	Daily	
Aeration Tank	SP-5	ML TSS & VSS	Weekly	
		Digester TSS & VSS	Weekly	
		RAS TSS & VSS	Weekly	
		Temperature	Daily	
		D.O.	Daily	
		PH	Weekly	
Clarifier Effluent	SP-6	TSS	Weekly	
		VSS	Weekly	
		SCOD	Weekly	
		TPH		Weekly
		PAH/PCP		Weekly
		NH_3	Weekly	
		Orthophosphate, dissolved	Weekly	
Multi-Media Filter Effluent	SP-8	TSS	Weekly	
		TPH		Weekly
		PAH/PCP		Weekly
Lead Carbon Filter Effluent	SP-9	TPH		Weekly
		PAH/PCP		Weekly
Lag Carbon Filter Effluent	SP-10	TPH		Weekly
		PAH/PCP		Weekly

Notes:
All performance samples are grab samples.
Performance monitoring samples will be collected Monday of each week and shipped via overnight courier to Manchester Laboratory for delivery on Tuesday of each week.
Up to four additional performance monitoring samples can be collected each week and analyzed for one or more of the following parameters: PAH, PCP, and oil and grease.

Key to Parameters

PAH =	Polynuclear aromatic hydrocarbons	RAS =	Return activated sludge
PCP =	Pentachlorophenol	VSS =	Volatile suspended solids
TCOD =	Total chemical oxygen demand	NH_3 =	Ammonia as nitrogen
SCOD =	Soluble chemical oxygen demand	TPH =	Total Petroleum Hydrocarbon
TSS =	Total suspended solids	pH =	Hydrogen ion
D.O. =	Dissolved oxygen	ML =	Mixed liquor

Table 2-5
Sample Handling Requirements for Process Monitoring

Analysis	Type of Container	Sample Volume	Sample Preservation	Sample Holding Time
Ammonia as Nitrogen (NH_3)	500 ml glass jar with poly-lined, baked poly cap	500 ml; fill to shoulder of bottle	Cool, 4°C; H_2SO_4 to pH < 2	As soon as possible, 28 days maximum
Chemical Oxygen Demand (total)	500 ml glass jar with poly-lined, baked poly cap	500 ml; fill to shoulder of bottle	Cool, 4°C; H_2SO_4 to pH < 2	As soon as possible, 28 days maximum
Chemical Oxygen Demand (soluble)	500 ml glass jar with poly-lined, baked poly cap	500 ml; fill to shoulder of bottle	Cool, 4°C; laboratory will filter	As soon as possible, 28 days maximum
Total Petroleum Hydrocarbons	One 1-liter amber glass bottle with Teflon-lined black phenolic cap	1 liter; fill to shoulder of bottle	Cool, 4°C, HCl to pH < 2	As soon as possible, 7 days maximum to extraction
Oil & Grease	1-liter glass bottle with poly-lined, baked poly cap	750 ml; fill to 3/4 full	Cool, 4°C; H_2SO_4 to pH < 2	As soon as possible, 28 days maximum
Orthophosphate, Dissolved	500 ml glass jar with poly-lined, baked poly cap	500 ml; fill to shoulder of bottle	Cool, 4°C; laboratory will filter	As soon as possible, 48 hours maximum
PCP	One 1-liter amber glass bottle with Teflon-lined black phenolic cap	1 liter; fill to shoulder of bottle	Cool, 4°C	7 days to extraction, 40 days after extraction
PAHs	One 1-liter amber glass bottle with Teflon-lined black phenolic cap	1 liter; fill to shoulder of bottle	Cool, 4°C	7 days to extraction, 40 days after extraction
Total Suspended Solids	500 ml glass jar with poly-lined, baked poly cap	500 ml; fill to shoulder of bottle	Cool, 4°C	As soon as possible, 7 days maximum
Volatile Suspended Solids	500 ml glass jar with poly-lined, baked poly cap	500 ml; fill to shoulder of bottle	Cool, 4°C	As soon as possible, 7 days maximum

Notes:
Shading indicates analyses to be performed at onsite laboratory.

Table 2-6
Chemical Compliance Monitoring Automated Composite Sample Volumes

Sample Type	Containers	Volume (gallons)
Original Sample (PAHs, PCP, TSS)	Three 1-liter jars	0.8
Field Duplicate	Same as above	0.8
MS/MSD	Four 1-liter jars (no MS/MSD for TSS)	1.1
	TOTAL	2.7

Table 2-7
Chemical Compliance Monitoring Sampling Schedule

Location	Sampling Location	Parameter	Analysis Performed at Onsite Laboratory	Analysis Performed at Offsite Laboratory
Effluent Storage Tank	SP-11	PAH[a]		X
		PCP[a]		X
		Discharge Flow Rate	X	
		TSS[a]		X
		TDS		X
		Temperature	X	
		pH	X	
		Dissolved Oxygen	X	

[a]24-hour composite sample.

Table 2-8
Sample Handling Requirements for Chemical Compliance Monitoring

Analysis	Type of Container	Sample Volume	Sample Preservation	Sample Holding Time
PAHs	One 1-liter amber glass bottle with Teflon-lined black phenolic cap	1 liter; fill to shoulder of bottle	Cool, 4°C	7 days to extraction, 40 days after extraction
PCP	One 1-liter amber glass bottle with Teflon-lined black phenolic cap	1 liter; fill to shoulder of bottle	Cool, 4°C	7 days to extraction, 40 days after extraction
Total Dissolved Solids	1-liter high-density polyethylene bottle with poly-lined, baked poly cap	1 liter; fill to shoulder of bottle	Cool, 4°C	As soon as possible, 7 days maximum
Total Suspended Solids	1-liter high-density polyethylene bottle with poly-lined, baked poly cap	1 liter; fill to shoulder of bottle	Cool, 4°C	As soon as possible, 7 days maximum

Table 2-9
Effluent Wastewater Biological Compliance Monitoring- Sampling Schedule

Location	Sampling Location	Analytical Procedure	Sampling Frequency
Effluent Storage Tank	SP-11	Acute survival test - *Menidia beryllina* (Inland Silversides)	Annual
		Chronic test - *Mytilus Sp.* (blue mussel) or *Crassostrea gigas* (Pacific oyster)	Quarterly

Table 2-10
Biological Compliance Monitoring Analytical Requirements

Organism	Test Protocol	QA Protocol
Acute Toxicity		
Menidia beryllina (Inland Silversides)	The test protocol is adapted from C.I. Weber, et al., *Methods for Measuring the Acute Toxicity of Effluents to Freshwater and Marine Organisms*, EPA/600/4-90/027, 1991.	All QA criteria used are in accordance with *Methods for Measuring the Acute Toxicity of Effluents to Freshwater and Marine Organisms*, EPA/600/4-90/027. Test results that are not valid (e.g., control mortality exceeds acceptable level) will not be accepted and must be repeated.
Chronic Toxicity		
Mytilus Sp. (blue mussel) or *Crassostrea gigas* (Pacific oyster)	*Standard Guide for Conducting Static Acute Toxicity Tests Starting with Emryos of Saltwater Bivalve Molluscs*, ASTM E 724-89 (as per PTI 1994, see Appendix A of the QAPP).	*Methods for Measuring the Acute Toxicity of Effluents to Freshwater and Marine Organisms*, EPA/600/4-85-013, *Quality Assurance Guidelines for Biological Testing*, EPA/600/4-78-043, and *Standard Guide for Conducting Static Acute Toxicity Tests Starting with Embryos of Saltwater Bivalve Molluscs*, ASTM E 724-89. Test results that are not valid (e.g., control response exceeds acceptable level) will not be accepted and must be repeated.

Table 2-11
Biological Compliance Monitoring – Biomonitoring Sample Handling Requirements

Test Type	Test Type/Organism	Sample Type[a]	Type of Container	Sample Volume	Sample Preservation	Sample Holding Time
Acute Definitive Toxicity Test	Estuarine fish [*Menidia beryllina* (Inland Silversides)]	Composite	Two 2.5-gallon HDPE cubitainers with polyethylene-lined plastic caps	5 gallons; fill to eliminate head space	Cool to 4^0C	As soon as possible, 36 hours maximum
Chronic Toxicity Test	Mussel/oyster—*Mytilus Sp.* (mussel) or *Crassostrea gigas* (Pacific oyster) larvae[b]	Composite	One 2.5-gallon HDPE cubitainer with polyethylene-lined plastic cap	2.5 gallons; fill to eliminate head space	Cool to 4°C	As soon as possible, 36 hours maximum

[a]Equal sample volumes will be collected at regular intervals over a period of 24 hours. Sample aliquots will be kept cool (on ice) and in darkness during compositing over the 24-hour sampling period.
[b]The organism chosen for this test will depend upon which species is spawning at the time of sample collection.

Table 2-12
Groundwater Monitoring Sampling Locations and Sampling Schedule

Location	Sampling Locations	Location Description	Total Number of Samples		
			Before TTP	During TTP	After TTP
Upper Aquifer	MW-17	100' NW of thermal treatment area	1		2
	MW-18	25' NW of thermal treatment area	1		2
	MW-19	200' SW of thermal treatment area	1		2
	EW-04*	NE end of thermal treatment area	1		2
	EW-06*	Center of thermal treatment area	1		2
	EW08	100' E of thermal treatment area	1		2
Lower Aquifer	CW-05	400' N of thermal treatment area	1	3	3
	CW-09	200' NE of thermal treatment area	1	3	3
	CW-15	400' N of thermal treatment area	1	3	3
	99CD-MW02	100' N of thermal treatment area	1	3	3
	99CD-MW04	50' N of thermal treatment area	1	3	3

TTP = Thermal Treatment Pilot.
*Location is an extraction well located within the pilot thermal treatment area.

Table 2-13
Groundwater Monitoring Parameters and Analytical Schedule

Location	Sampling Locations	Parameter	Analyzed at Contactor Laboratory	Analyzed at EPA Laboratory
Upper Aquifer	MW-17 MW-18 MW-19 EW-04 EW-06 EW08	Alkalinity	X	
		Total Organic Carbon	X	
		Nitrate/Nitrite	X	
		Sulfate/Sulfide	X	
		Chloride	X	
		Total Metals (Ca, Mn, Mg, Na and K)	X	
		Petroleum Hydrocarbons*		X
		PAHs/PCP*		X
Lower Aquifer	CW-05 CW-09 CW-15 99CD-MW02 99CD-MW04	Alkalinity	X	
		Total Organic Carbon	X	
		Nitrate/Nitrite	X	
		Sulfate/Sulfide	X	
		Chloride	X	
		Petroleum Hydrocarbons		X
		PAHs/PCP		X

*Parameter is only analyzed in upper aquifer wells during the initial baseline groundwater sampling event

Table 2-14
Sample Handling Requirements for Groundwater Monitoring

Analysis	Type of Container	Sample Volume	Sample Preservation	Sample Holding Time
Alkalinity	250 ml HDPE bottle with Teflon-lined cap	250 ml; fill to shoulder of bottle	Cool, 4°C	As soon as possible, 14 days maximum
Total Organic Carbon	125 ml HDPE bottle with Teflon-lined cap	125 ml; fill to shoulder of bottle	Cool, 4°C; H_2SO_4 to pH < 2	As soon as possible, 28 days maximum
Nitrate	125 ml HDPE bottle with Teflon-lined cap	125 ml; fill to shoulder of bottle	Cool, 4°C	48 hours
Nitrite	125 ml HDPE bottle with Teflon-lined cap	125 ml; fill to shoulder of bottle	Cool, 4°C	48 hours
Sulfate	125 ml HDPE bottle with Teflon-lined cap	125 ml; fill to shoulder of bottle	Cool, 4°C	As soon as possible, 28 days maximum
Sulfide	One 1-liter HDPE bottle with Teflon-lined cap	1 liter; fill to shoulder of bottle	Cool, 4°C; NaOH and ZnOAc to pH > 9	As soon as possible, 7 days maximum
Chloride	125 ml HDPE bottle with Teflon-lined cap	125 ml; fill to shoulder of bottle	Cool, 4°C	As soon as possible, 28 days maximum
Petroleum Hydrocarbons	One 1-liter amber glass bottle with Teflon-lined black phenolic cap	1 liter; fill to shoulder of bottle	Cool, 4°C; HCL to pH < 2	As soon as possible, 7 days maximum to extraction
PCP	One 1-liter amber glass bottle with Teflon-lined black phenolic cap	1 liter; fill to shoulder of bottle	Cool, 4°C	7 days to extraction, 40 days after extraction
PAHs	One 1-liter amber glass bottle with Teflon-lined black phenolic cap	1 liter; fill to shoulder of bottle	Cool, 4°C	7 days to extraction, 40 days after extraction

Table 2-15
Air Quality Monitoring Parameters and Sampling Frequency

Contaminant or Characteristic of Interest	Media	Number of Samples	Exposure Limits, Required Concentration or Sensitivity Limits	Sample Location/Type	Sample Frequency
Total Suspended Particles	Air	8	50/150 ug/m^3	2 monitor stations will be placed around the perimeter of the treatment plant with a Hi-Vol Sampler.	Samples will be collected every 24 hours with a Hi Vol sampler during three events.
PCP/Method TO-4A	Air	8	0.33 ug/m^3	2 monitor stations will be placed around the perimeter of the treatment plant (one upwind of operational activity and one downwind of the area). Samples will be collected with a Hi Vol Sampler/GC-MS.	Samples will be collected every 24 hours. Baseline sampling followed by three monitoring events once groundwater temperatures stabilize.
PAHs/Method TO-13A: acenaphthene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoroanthene, chrysene, dibenzo(a,h)anthracene, fluoroanthene, fluorene, indeno(1,2,3) pyrene, phenanthrene, pyrene, benzo(g,h,I)perylene	Air	8	0.00048 ug/m^3		
PAHs/Method TO-13A with XAD Resin: Naphthalene	Air	8	170 ug/m^3		

Table 2-16
Operational Phase Worker Safety Air Monitoring Locations and Sampling Schedule

Location	Description	Analyte
Treatment Plant DAF-104	Start-up at DAF tank. Two co-located samples for PCP	PCP
	Start-up at DAF tank. Two co-located samples for PAHs	PAHs
	Operational DAF tank. Two co-located samples for PCP	PCP
	Operational DAF tank. Two co-located samples for PAHs	PAHs
Treatment Plant T-203	Start-up at aeration basin. Two co-located samples for PCP	PCP
	Start-up at aeration basin. Two co-located samples for PAHs	PAHs
	Operational aeration basin. Two co-located samples for PCP	PCP
	Operational aeration basin. Two co-located samples for PAHs	PAHs
Treatment Area	Start-up at treatment area. Two co-located samples for PCP	PCP
	Start-up at treatment area. Two co-located samples for PAHs	PAHs
	Operational treatment area. Two co-located samples for PCP	PCP
	Operational treatment area. Two co-located samples for PAHs	PAHs
Blank Samples	Blank sample for start-up sampling for PCP	PCP
	Blank sample for start-up sampling for PAHs	PAHs
	Blank sample for operational sampling for PCP	PCP
	Blank sample for operational sampling for PAHs	PAHs

Table 2-17
Worker Safety Air Monitoring Sampling Set Up

Analyte	Method	Pump	Media	Flow Rate	Comments
PCP	OSHA 39	SKC Aircheck	Two XAD-7 tubes in series with glass fiber filter. (SKC # 226-97)	0.2 L/min. for 4hrs	Remove XAD-7 resin-filled front section of the sampling device before sampling and reattach afterward. Use two tubes in series with pre-filter.
PAHs*	OSHA 58	SKC Aircheck	Pre-weighed glass-fiber filter in a cassette. (SKC # 225-2 cassette, 225-7 filter)	2.0 L/min. for 8hrs	Seal cassette and wrap in aluminum foil for transport to lab.

*Naphthalene is included with the PAH sampling and analysis.

Table 2-18
Operational Phase Worker Safety Air Monitoring Locations and Sampling Schedule

Location	Sample ID	Description	Analyte	Total Number of Samples
Treatment Plant DAF-104	DAF-1A	Start-up at DAF tank, primary sample	PCP	1
	DAF-1B	Start-up at DAF tank, co-located duplicate	PCP	1
	DAF-1C	Start-up at DAF tank, primary sample	PAHs	1
	DAF-1D	Start-up at DAF tank, co-located duplicate	PAHs	1
	DAF-2A	Operational DAF tank, primary sample	PCP	1
	DAF-2B	Operational DAF tank, co-located duplicate	PCP	1
	DAF-2C	Operational DAF tank, primary sample	PAHs	1
	DAF-2D	Operational DAF tank, co-located duplicate	PAHs	1
Treatment Plant T-203	T203-1A	Start-up at aeration basin, primary sample	PCP	1
	T203-1B	Start-up at aeration basin, co-located duplicate	PCP	1
	T203-1C	Start-up at aeration basin, primary sample	PAHs	1
	T203-1D	Start-up at aeration basin, co-located duplicate	PAHs	1
	T203-2A	Operational aeration basin, primary sample	PCP	1
	T203-2B	Operational aeration basin, co-located duplicate	PCP	1
	T203-2C	Operational aeration basin, primary sample	PAHs	1
	T203-2D	Operational aeration basin, co-located duplicate	PAHs	1
Treatment Area	TA-1A	Start-up at treatment area, primary sample	PCP	1
	TA-1A	Start-up at treatment area, co-located duplicate	PCP	1
	TA-1A	Start-up at treatment area, primary sample	PAHs	1
	TA-1A	Start-up at treatment area, co-located duplicate	PAHs	1
	TA-2A	Operational treatment area, primary sample	PCP	1
	TA-2B	Operational treatment area, co-located duplicate	PCP	1
	TA-2C	Operational treatment area, primary sample	PAHs	1
	TA-2D	Operational treatment area, co-located duplicate	PAHs	1
Blank Samples	Blank 1-PCP	Start-up blank sample for PCP analysis	PCP	1
	Blank 1-PAH	Start-up blank sample for PAH analysis	PAH	1
	Blank 2-PCP	Operational blank sample for PCP analysis	PCP	1
	Blank 2-PAH	Operational blank sample for PAH analysis	PAH	1

Table 2-19
Estimated Primary Ambient Air Quality Parameter Emissions

Constituent	Potential to Emit* (pounds/hour)	Estimated Annual Emissions (tons/year)
CO	2.34	10.28
NOx	5.90	25.85
SOx	17.43	76.36
VOC	1.00	4.41
PM	0.83	3.67
*Based on the manufacturers emission factors		

Table 2-20
Boiler Air Emissions Monitoring

Contaminant or Characteristic of Interest	Media	Number of Samples	Exposure Limits, Required Concentration or Sensitivity Limits	Sample Collection Method
Dioxin/Furans	Air	Up to 4 Samples	WA State ASILS Limits	3-Hour integrated composite; Method M0023
PAHs	Air	Up to 4 Samples	WA State ASILS Limits	3-Hour integrated composite; Method M0010
Volatile Organics	Air	Up to 12 Samples	WA State ASILS Limits	20 minutes per pair; 6 pairs per run; Method M0030 (VOST)
Semivolatile Organics	Air	Up to 4 Samples	WA State ASILS Limits	3-Hour integrated composite; Method M0010
Total Hydrocarbons	Air	Up to 4 Samples	CAA Limits	Continuous or Tedlar Bag; Method M0025A or M0018
Hydrogen Chloride and Chlorine	Air	Up to 4 Samples	PSCAA Limits	2-Hour Integrated Composite; Method M0050
Particle Size	Air	Up to 4 Samples	PSCAA Limits	Integrated Composite; EPA Method 201A or 202

Table 2-21
Joint Observation Well Water Quality Monitoring Requirements

Sampling Location	Media	Contaminant or Characteristic of Interest	Analytical Method	Sampling Frequency
J09 J10 J11	Groundwater	Semivolatile organics (including naphthanols and quinones)	EPA SW-846 Method 8270C TAL with TICs	Within three months of sheet pile wall installation and after active steam injection

Table 2-22
Waste Disposal Requirements

Waste	Designation	Sampling Required?	Disposal Method
Recovered NAPL	F032, F034, D025 (p-cresol), D037 (pentachlorophenol), WP03 (EHW)	No	Incineration
Dewatered Biosolids/Sludge, and sump, aeration basin, and separator sediments	F032, F034, and possibly D025 (p-cresol), D037 (pentachlorophenol), WP03 (EHW) depending on results of analysis	Yes	Landfill[1] or Incineration if results are above LDR
Spend Granular Activated Carbon and Spent Filter Media	F032, F034, D025 (p-cresol), D037 (pentachlorophenol), WP03 (EHW)	Yes	Landfill or Incineration if results are above LDR
Onsite Lab Waste	Varies	No	Lab Pack & Dispose according to contents
Drill Cuttings	NA	No	Designated on-site stockpile
Well development/Purge Water	NA	No	Onsite water treatment plant
PPE and creosote contaminated material	F032, F034	No	Landfill
[1] Landfill = RCRA Part B Subtitle C Landfill			

Table 2-23
Waste Characterization Requirements

Contaminant or Characteristic of Interest	Media	Number of Samples	Required Concentration or Sensitivity	Sample Location
PAHs: Acenaphthene, Anthracene, Benzo(a)anthracene, Benzo(a)pyrene, Chrysene, Fluorene, Inden(1,2,3-cd)pyrene	Granular Activated Carbon (non-wastewater)	not determined at this time	3.4 mg / kg	Spent Activated Carbon (SAC)
PAHs: Naphthalene, Phenanthrene	GAC	not determined at this time	5.6 mg / kg	SAC
PAHs: Benzo(b)fluoranthene, Benzo(k)fluoranthene	GAC	not determined at this time	6.8 mg / kg	SAC
PAHs: Pyrene, Dibenz(a,h)anthracene	GAC	not determined at this time	8.2 mg / kg	SAC
PCP	GAC	not determined at this time	7.4 mg / kg	SAC
Dioxin / Furans	GAC	not determined at this time	0.001 mg / kg	SAC
TCLP (volatile, semivolatile, pesitcides, and herbicides)	GAC	not determined at this time	wide range, see RCRA code for specific compounds and sensitivities	SAC
PAH (individual components - see above listings for specifications)	Supersand Filter (non-wastewater)	not determined at this time	variable (see above: non-wastewater)	Spent filter media
PCP	SSF	not determined at this time	7.4 mg / kg	Spent filter media
Dioxin / Furans	SSF	not determined at this time	0.001 mg / kg	Spent filter media
TCLP (volatile, semivolatile, pesitcides, and herbicides)	SSF	not determined at this time	wide range, see RCRA code for specific compounds	Spent filter media
PAH (individual components - see above listings for specifications)	Bioreactor sludge (non-wastewater)	not determined at this time	variable (see above: non-wastewater)	Sludge Holding Tank
PCP	Bioreactor sludge	not determined at this time	7.4 mg / kg	Sludge Holding Tank
Dioxin / Furans	Bioreactor sludge	not determined at this time	0.001 mg / kg	Sludge Holding Tank
TCLP (volatile, semivolatile, pesitcides, and herbicides)	Bioreactor sludge	not determined at this time	wide range, see RCRA code for specific compounds	Sludge Holding Tank

Figure 2-1
Pilot Area Wellfield as Installed

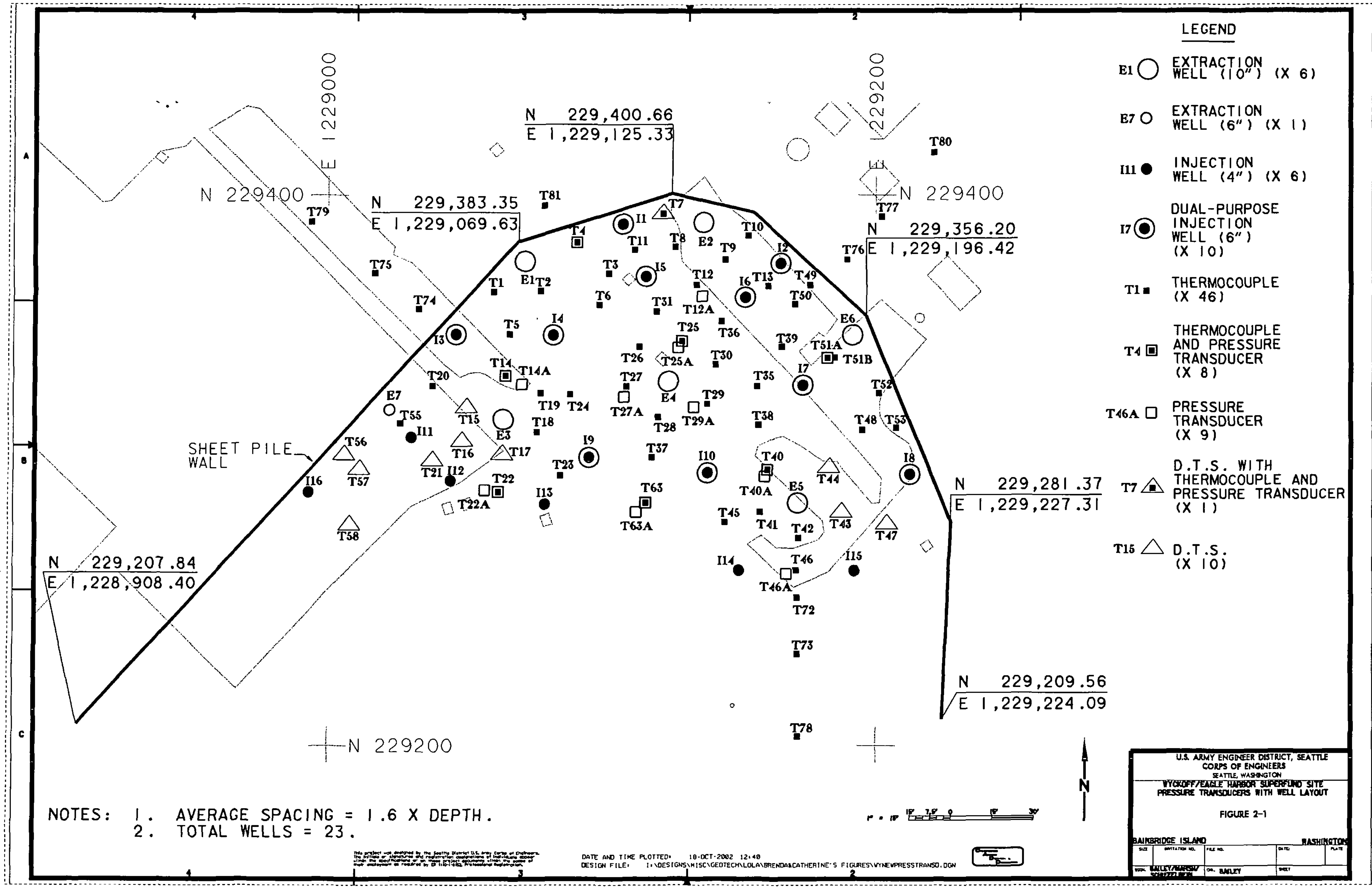


Figure 2-2
Well Construction Details

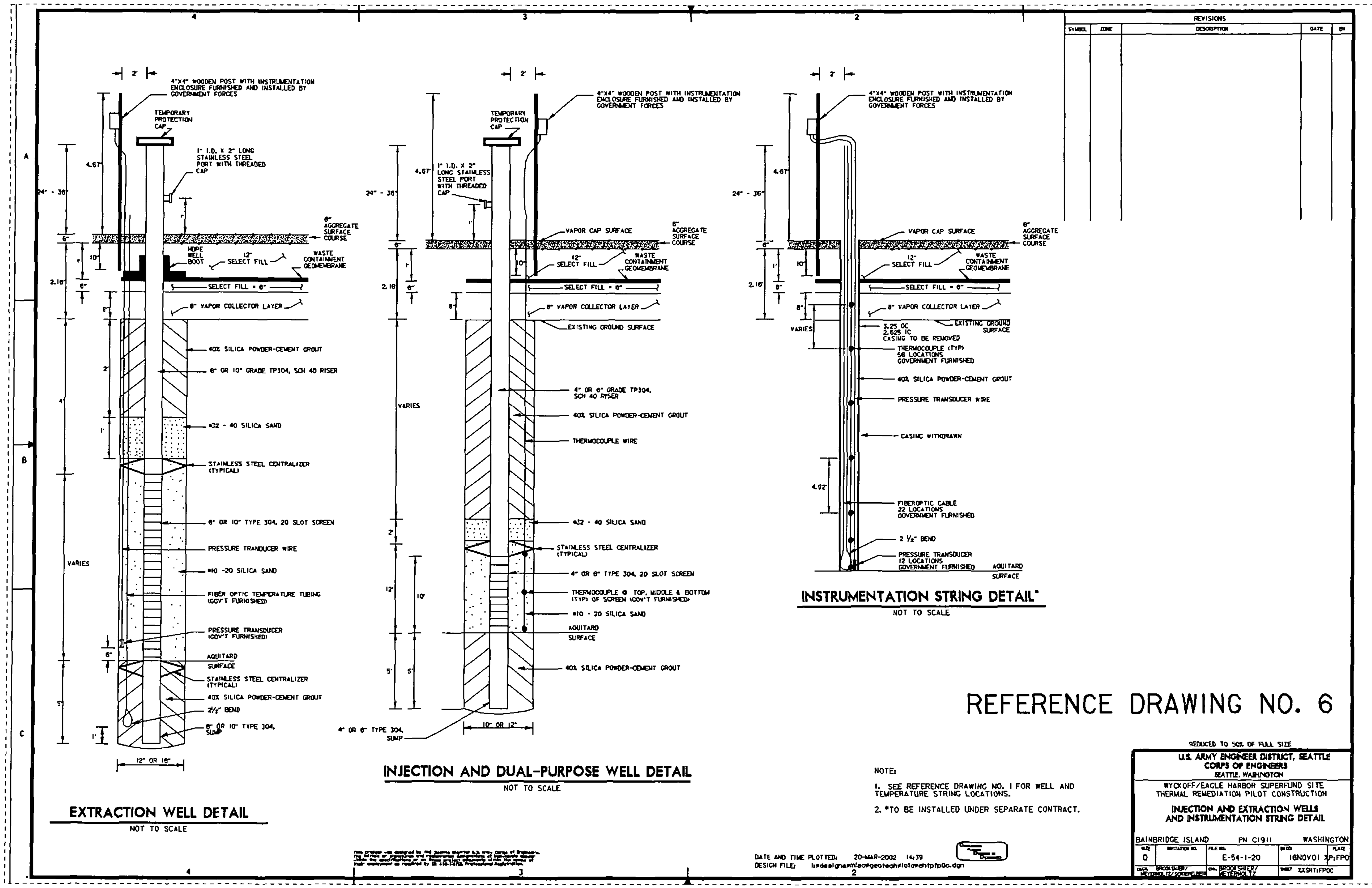
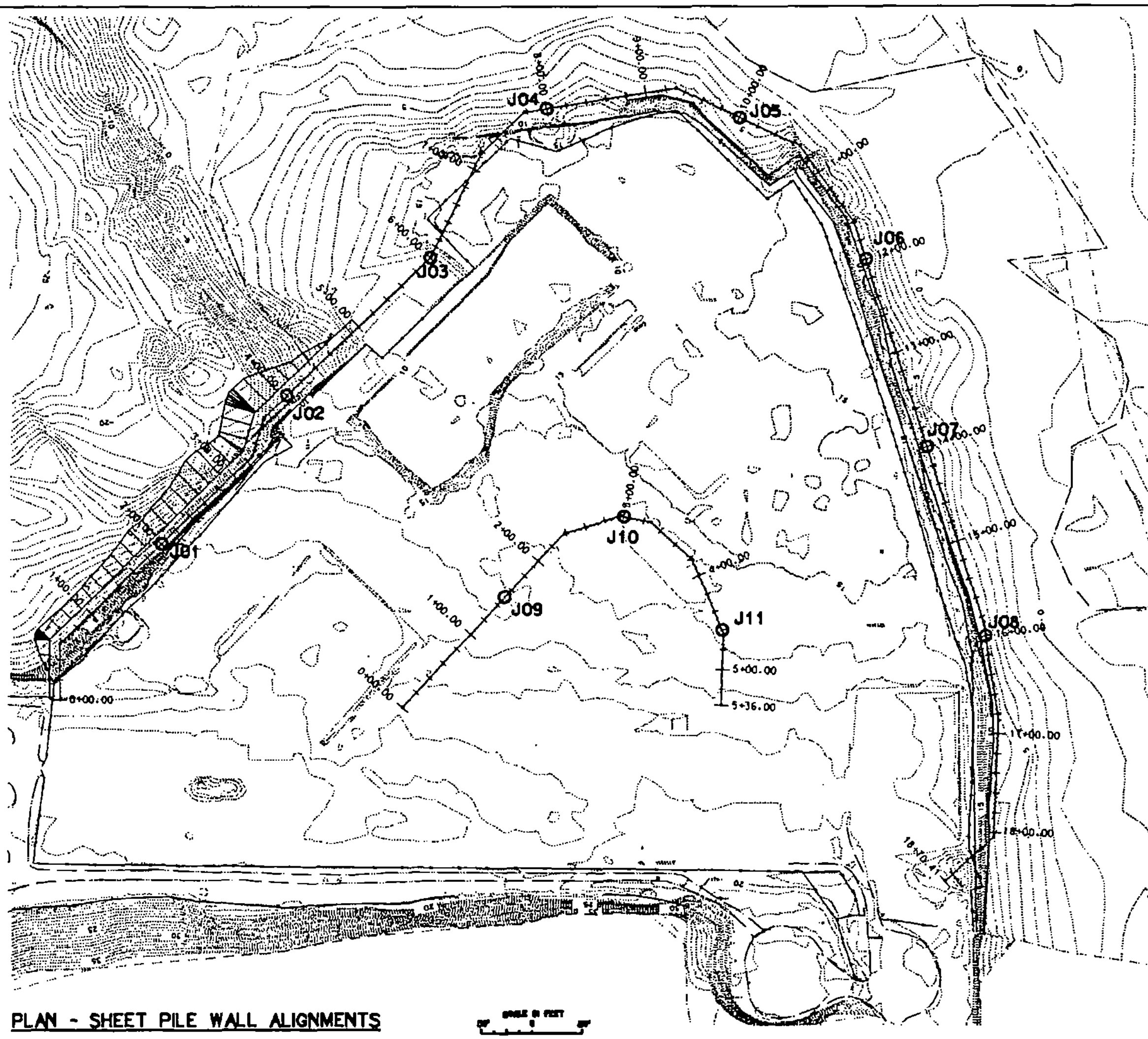


Figure 2-3
Joint Observation Well Locations



NOTES :

1. HORIZONTAL DATUM IS WSPCS NAD83.
2. VERTICAL DATUM IS MEAN LOWER LOW WATER (MLLW).

KEY:

O J01 = JOINT OBSERVATION WELL

3.0 FIELD DOCUMENTATION AND SAMPLE MANAGEMENT

This section describes the procedures for documentation and sample management in the field, including field documentation (i.e., information to be included in field logbooks), sample documentation (i.e., EPA-assigned project codes and sample numbers, the various chain-of-custody and analytical request forms, sample tags and labels, and chain-of-custody procedures), packaging, and shipping.

3.1 FIELD DOCUMENTATION

All field sampling activities will be documented using SCS Engineers' Groundwater Sampling Data Sheet (for groundwater samples) or Field Sampling Record (for other media) forms. These field forms provide for recording the following information:

- Project and site identification;
- Date and time of sample collection;
- Physical/environmental conditions during field activities;
- Personnel involved with the activities;
- Well/sample location identification;
- Sample descriptions;
- Field parameter measurements;
- Equipment used for sample collection;
- Sample duplicates, splits, and blanks, if applicable
- Unusual activities, such as departures from planned procedures and equipment breakdowns

All logs will be completed, signed, and dated by the recorder. All logs will be written with waterproof ink. Corrections will be made by crossing out the error with a single horizontal line, initialing the correction, and entering the correct information. Crossed-out information shall be readable.

3.2 SAMPLE DOCUMENTATION

At least two weeks prior to the first week of sampling, a memorandum will be sent to the EPA Customer Service Office (CSO) notifying them of the scheduled sampling event (known as a "project"). The CSO will assign the project the following:

- Laboratory(s)
- Project code
- Sample numbers

3.2.1 Laboratory Assignments

The CSO will assign laboratories based on the project's analytical requirements, laboratory cost and availability. When possible, analyses will be performed at the EPA Manchester Laboratory; otherwise, analyses will either be performed by private laboratories contracted by EPA to conduct routine analytical services (RAS) or performed by subcontracted private laboratories. The CSO will provide specific directions on sample documentation procedures when nonstandard laboratories are contracted.

Off-site analyses for groundwater inorganics (alkalinity, TOC, nitrate, nitrite, sulfate, sulfide, chloride and total metals), non-condensable gas parameters (PAHs/PCP, CO_2 and O_2), and operational phase worker safety air monitoring will be performed by Severn Trent Laboratories, a private laboratory under subcontract to SCS Engineers. Biological monitoring of effluent discharge will be performed by Northwest Aquatic Sciences Laboratory.

3.2.2 Project Code

A project code will be assigned by the CSO that must be recorded on all sample documentation, including analytical requests, chain-of-custody forms, sample tags, and custody seals.

3.2.3 Sample Numbers

The CSO will provide a block[1] of unique eight-digit sample numbers that correspond to the week that the samples are scheduled to be collected. The first four digits represent the year and the week. The sample numbers are valid for Monday through Saturday of that week.[2] These eight-digit sample numbers are herein referred to as EPA-assigned sample numbers. At the same time, EPA will also provide RAS case numbers, as required. RAS case numbers will have different formats and will not be interchangeable with the EPA-assigned sample numbers.

3.3 SAMPLE DOCUMENTATION FORMS

All documentation forms, including chain-of-custody forms, analysis requests, sample tags, and custody seals, will be provided as necessary by the CSO and include the following:

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[1] Blocks of 10, 25, 50, or 100 are available.

[2] Special arrangements need to be made for Sunday sampling.

- Field Sample Data
- Chain of Custody Sheet
- EPA Region 10 Analysis Request Forms
- RAS Traffic Report and Chain of Custody Records
- Sample tags

Blank chain-of-custody forms for tracking all the environmental samples to be submitted to SCS Engineers' subcontract laboratories will be directly provided along with the sampling containers by each of the receiving contract laboratories.

3.3.1 Field Sample Data and Chain-of-Custody Sheet

A Field Sample Data and Chain-of-Custody Sheet (FSD/COC) must accompany all samples shipped to EPA laboratories for analysis. After completing this form, the sampler includes the first (white) copy with the sample shipment to the laboratory, returns the second (yellow) copy to the CSO, and retains the third (pink) copy for the project files.

3.3.2 EPA Region 10 Analysis Request Forms

For analyses performed by EPA, additional forms are required, used in conjunction with the FSD/COC, for metals, physical and general inorganics, general organics, ion chromatography, oxygen demand, solids, and nutrients. After completing these forms, the sampler will include the top (white) form with the sample shipment to the analysis laboratory. Following sample shipment, the sampler will retain the second (blue) copy for the project files.

3.3.3 RAS Inorganic and Organic Traffic Report and Chain-of-Custody Records

RAS Inorganic or Organic Traffic Report and Chain-of-Custody Record (TR/COC) forms will be used for all RAS samples. After completing the RAS TR/COC, the sampler will include the bottom two (white and yellow) copies with the sample shipment to the analysis laboratory. Following sample shipment, the sampler sends the first (green for inorganics, blue for organics) and the second (pink) copy to the CSO after making a photocopy for the project files.

3.3.4 Sample Tags

The information recorded on the sample tag includes:

- Project Code—the number assigned by the EPA to the sampling project
- Station Number—A station number will be assigned to each sampling location
- Month/Day/Year—A six-digit number indicating the date of collection

- Time—A four-digit number indicating the military time of collection
- Designate: Preservative—A box that should be checked appropriately to indicate ice or none
- Designate: Chemical—A box that should be checked appropriately if a chemical preservation is used
- Station Location—This is the location of the sampling event
- Samplers—Signatures of samplers on the project team
- Remarks—Type of chemical preservative, if any, as well as any pertinent comments
- Tag No.—A unique serial number preprinted or stamped on the tag
- Lab Sample No.—The EPA-assigned eight-digit sample number provided by the CSO

Additionally, the sample tag contains appropriate spaces for indicating the analytical parameter(s) for which the sample will be analyzed.

After the sample tag is completed, each tag will be securely attached to the sample container using clear packing tape.[3] Samples for RAS include adhesive labels preprinted with individual RAS sample numbers, which are provided by the CSO. The sampler will affix the sample labels to the corresponding containers that make up the sample. The labels will be covered with clear tape to protect the label from water. Samples will then be shipped under chain-of-custody procedures as described in the following section.

3.4 CHAIN-OF-CUSTODY PROCEDURES

In accordance with EPA enforcement requirements, official custody of samples will be maintained and documented from the time of collection until the time of introduction as evidence during litigation, if required.

A sample will be considered to be in an individual's custody if any of the following criteria are met: (1) the sample is in your possession or it is in your view after being in your possession; (2) it was in your possession and then locked up or sealed to prevent tampering; or (3) it is in a secured area. The sampling team leader will be responsible for the care and custody of the collected samples until they are dispatched properly. In follow-up, the sampling team leader will review all field activities to confirm that proper custody procedures were followed during the fieldwork.

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[3] Except for volatile organic analysis (VOA) vials, where sample tags are attached to the vials using rubber bands.

The Chain-of-Custody Record is physical evidence of sample custody. A Chain-of-Custody Record will be completed to accompany each cooler shipped from the field to the laboratory.

One member of the sampling team will be designated as the recorder, and that person will complete all of the paper work associated with one Chain-of-Custody Record. However, each sampling team member must also initial the Chain-of-Custody Record in the designated area. For each station number, the recorder is to indicate the date, time, whether the sample is a composite or grab, station location, number of containers, analytical parameters, sample label number(s), and preservatives used. When shipping the samples, the recorder signs the bottom of the form and enters the date and time the samples are relinquished. The shipper name and airbill number are to be entered under the remarks section in the bottom right corner of the form. Samples that are hand delivered to the laboratory will also be identified here.

The Chain-of-Custody Record form is to be completed using waterproof ink. Corrections are to be made by drawing a line through the error, initialing and dating the error, then entering the correct information.

The original signature copy of the Chain-of-Custody Record will be enclosed in plastic and secured to the inside of the cooler lid. A copy of the custody record will be retained for the sampler's files.

Shipping coolers will be secured, and EPA custody seals will be placed across cooler openings. As long as the Chain-of-Custody Record forms are sealed inside the sample cooler and remain intact, commercial carriers will not be required to sign the record when they receive and relinquish the samples.

The laboratory representative who accepts the incoming sample shipment will sign and date the Chain-of-Custody Record to acknowledge receipt of the samples. Once the sample transfer process is complete, the laboratory will be responsible for maintaining internal logbooks and records that provide a custody record throughout sample preparation and analysis.

3.5 SAMPLE PACKAGING AND SHIPPING

Once sealed, sample bottles shall be wrapped with self-adhering bubble wrap, then enclosed in clear plastic bags. Sample bottles should be placed upright in an iced cooler immediately after the samples have been collected and packed. The cooler drain plug should be taped shut inside and out. Coolers to be shipped via courier will be packed with cardboard or other cushion material surrounding the bottles to prevent breakage during transport and to absorb liquid if breakage does occur. Ice will be sealed in plastic bags to prevent melting ice from soaking the packing material. Sample documentation will be enclosed in sealed plastic bags and taped to the underside of the cooler lid. Coolers will be secured with strapping tape and custody seals and delivered to the appropriate laboratory by the sampling team or by overnight courier within 48 hours of collection.

4.0 QUALITY CONTROL SAMPLES

Field quality control (QC) samples will be collected for compliance sampling. This includes field duplicates and matrix spike/matrix spike duplicates. No field duplicate samples or other quality control samples will be collected as part of the Pilot Process Monitoring.

One field duplicate sample will be collected at a minimum frequency of once every 4 weeks. A field duplicate is an independent sample collected as close as possible to the original sample from the same source.

Matrix spike/matrix spike duplicates will be collected at a minimum frequency of once every 4 weeks. A matrix spike is an aliquot of sample spiked with a known concentration of target analyte(s). The matrix spike duplicate is a laboratory split sample of the spike.

Field QC samples will not be collected during biomonitoring. To verify the integrity of sampling, EPA may observe field sampling procedures and may take field duplicates for analysis.

PE samples will be collected for performance and compliance monitoring as detailed in the QAPP.

5.0 DECONTAMINATION PROCEDURES

The objectives of decontamination are to prevent the introduction of contaminants into samples from sampling equipment or other samples, to prevent contamination from leaving the sampling equipment, personnel, or other materials, and to prevent exposure of field personnel to contaminated materials. This section outlines procedures that will be followed to meet decontamination objectives.

5.1 SAMPLING EQUIPMENT

Non-dedicated sampling equipment will be cleaned using the wash/rinse sequence described below before initial use, and after any unusual occurrence that may compromise future samples (such as dropping the sampler receptacle on the ground).

1. TSP solution wash (except location SP-6 were orthophosphate is a target analyte)
2. Tap water rinse
3. Isopropanol water rinse (no dilution)
4. Distilled water rinse
5. Air dry
6. Distilled water rinse (prior to next use if not used immediately)

5.2 SAMPLE CONTAINERS

The outside of sample containers will be cleaned by wiping the container with a paper towel dampened with distilled water prior to delivering the sample to the laboratory.

5.3 PERSONNEL

Performance monitoring and compliance monitoring will be conducted in Level D protection. Level D includes coveralls (washable cotton or Tyvek®), neoprene boots or disposable shoe covers (optional), outer neoprene gloves, vinyl or latex inner gloves, and safety glasses. Disposable latex gloves may also be worn on the outside of the outer neoprene gloves. Decontamination procedures for Level D include the following steps:

1. Remove disposable shoe covers (if worn) and discard according to procedures discussed in Section 6, Disposal of Sampling-Derived Waste.
2. Wash visible soil from neoprene boots, using a TSP solution. Rinse boots with tap water.
3. Wash visible soil from neoprene outer gloves, using TSP solution. Rinse gloves with tap water.

4. Remove outer gloves and discard in 55-gallon drum if visible soil or oil contamination cannot be removed.

5. Remove disposable overalls and discard according to procedures discussed in Section 6, Disposal of Sampling-Derived Waste.

6. Remove disposable inner gloves and discard.

7. Wash hands and face with soap and water.

Regardless of the level of protection required, field personnel should thoroughly wash their hands and faces before taking any work breaks and at the end of the day.

Personnel decontamination should be conducted, at a minimum, before extended work breaks, at the end of each working day, and between sample sites if the potential exists for contaminated clothing to impact site activities or personal health.

6.0 DISPOSAL OF SAMPLING-DERIVED WASTE

Sampling-derived personal protective wastes and disposable equipment, such as gloves, Tyvek®, boot covers, sample tubing, etc., will be deposited into the personal protective equipment (PPE) drums located on the GWTP pad or near the site boot-wash area. Drum contents will be disposed of by the site's waste disposal contractor at an approved waste handling facility.

Contaminated purge water or decon water will be disposed of to the treatment plant or a designated decontamination area on the site.

Analytical waste, generated as part of the in-house laboratory duties, shall be stored and disposed of as separate waste streams. Analytical wastes include the following:

- COD vials. These vials contain sample and spent chemicals from the Hach low-range COD test.

- Acid preservative vials. These vials contain residue from acid preservatives (sulfuric acid).

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QUALITY ASSURANCE PROJECT PLAN

Thermal Treatment Pilot Study
Wyckoff Facility and Groundwater Operable Units
Wyckoff/Eagle Harbor Superfund Site
Kitsap County, Washington

Prepared for:

U.S. Environmental Protection Agency
Region 10
1200 6th Avenue
Seattle, Washington 98101

Prepared by:

U.S. Army Corps of Engineers
Seattle District
4735 East Marginal Way South
Seattle, Washington 98134

and

SCS Engineers
2405 140th Avenue NE
Suite 107
Bellevue, Washington 98005-1877

November 2002

Quality Assurance Project Plan

Thermal Treatment Pilot Study
Wyckoff Facility and Groundwater Operable Units
Wyckoff/Eagle Harbor Superfund Site
Kitsap County, Washington

A 1.0 APPROVAL PAGE

Approved ________________________________ Date ________
EPA Region 10 Remedial Project Manager

Approved ________________________________ Date ________
EPA Region 10 Quality Assurance Manager

Approved ________________________________ Date ________
USACE Project Manager

Approved ________________________________ Date ________
USACE Site Manager

Approved ________________________________ Date ________
SCS Contract Manager

Approved ________________________________ Date ________
SCS Quality Control Manager

A 2.0 CONTENTS

A. PROJECT MANAGEMENT

A3.0 DISTRIBUTION LIST

U.S. Environmental Protection Agency
Region 10
1200 6th Avenue
Seattle, WA 98101

Attention: Hanh Gold, Bruce Woods, and Laura Castrilli

U.S. Army Corps of Engineers
Seattle District
4735 East Marginal Way South
Seattle, WA 98134

Attention: M. Kathy LeProwse, Travis Shaw, Brenda Bachman, and Michael Bailey

SCS Engineers
2405 140th Avenue NE
Suite 107
Bellevue, WA 98005-1877

Attention: David Roberson, Cliff Leeper, and Joe Harrington

URS Corporation
1501 4th Avenue
Suite 1400
Seattle, WA 98101

Attention: Ty Griffith

A 4.0 PROJECT ORGANIZATION

The U.S. Army Corps of Engineers (USACE) is providing remedial design and remedial action services for the U.S. Environmental Protection Agency (EPA) Region 10 for the Wyckoff/Eagle Harbor Superfund Site, located on Bainbridge Island, Washington. USACE has designed a pilot study that will determine the effectiveness of innovative thermal remediation to enhance the recovery of nonaqueous-phase liquids (NAPLs) from the site. This work will be performed to meet the requirements of the Record of Decision (ROD) for the Soils and Groundwater Operable Units (OUs) (USEPA 2000).

A 4.1 Communication Strategy

Accelerated approaches to sampling, analysis and operational decision making, as required for this project, integrate various tasks and measurements into a single coordinated effort. Accelerated approaches are conducted by a multidisciplinary group of experienced professionals, working as a team in several locations to evaluate the data and coordinate the activity between various government and contractor teams toward achievement of specific project objectives. Project team members and inter-group communication strategies are described below and shown on Figure 1.

A 4.1.1 PROJECT TEAM

The project team consists of representatives from EPA Region 10, the USACE Seattle District Office, and numerous contractors. The project team provides the overall framework for the construction, operations, maintenance and data collection approach by defining project objectives and data quality requirements, and ensuring that both the objectives and data quality requirements are met during the execution of the Thermal Pilot Study.

Providing oversight for the project team throughout the process are individuals identified to ensure that project quality assurance/quality control and health and safety issues are addressed. At any time, any individual working on the project may contact the Industrial Hygienist, QA/QC Officer or the Health and Safety Officer to discuss project issues or concerns. It is the responsibility of the QA/QC Officer and the Health and Safety Officer to implement corrective actions if he/she feels project requirements are not being met.

The project team must keep the EPA RPM (Hanh Gold) informed of how the project is proceeding. The approval of EPA is required for any major deviations in the work. Project updates will be given to the EPA RPM by the USACE PM (Kathy LeProwse) during regularly scheduled meetings, phone calls, e-mails or faxes. The RPM will consult and coordinate with other EPA project team members as necessary. The USACE PM is a member of the Operations Team (below) and will be in daily contact with the Site Manager.

A 4.1.2 THERMAL OPERATIONS TEAM

Within the project team is a core technical team made up of individuals who have developed site-specific expertise in geologic, hydrologic, and chemical analytical methods and operational approaches for the site. They provide a continual, integrated, and multidisciplinary presence throughout the process. The members of the core technical team form the primary operational team designated as the Operations Team. The optimization of field activities depend on the interaction among the members of the Operations Team and the EPA, each providing their own special perspective on the site.

The Operations Team oversees analysis of the raw data and recommends to the Operations Team Coordinator the next measurements that best meet project objectives. Members of the Oprations Team should have whole-site-systems understanding of geology, hydrogeology, and contaminant chemistry. They work together to evaluate the data as they are obtained. Their most important role is integrating and understanding how data will be used to meet specific project goals. The ability to integrate their technical expertise with that of the other members of the core technical team is crucial to the success of the project.

The Government Project Manager designates one Operations Team member as Operations Team Coordinator. The Coordinator shall coordinate and facilitate the team's decision-making process, ensuring that input is received from each member and other appropriate qualified sources. Every reasonable attempt shall be made to reach consensual team agreements; however if a consensus cannot be reached, the Government shall have final decision-making authority, exercised through the Operations Team Coordinator. Each Operations Team member shall have a designated backup member, who shall assume their responsibilities in their absence.

Based on earlier planning discussions, USACE PM Kathy LeProwse and EPA RPM Hanh Gold had designated the Ops Team membership to include the following individuals:

- Hanh Gold – EPA RPM
- Kathy LeProwse – USACE PM
- Travis Shaw – USACE Site Manager
- Mike Bailey – USACE Hydrogeologist
- Brenda Bachman – USACE Monitoring Coordinator
- Cliff Leeper/Joe Harrington – SCS Engineers (O&M Contractor)
- Gorm Heron – Steamtech, Inc. (Expert Consultant)

The Operations Team members have defined the primary role of the team as the decision making body responsible for daily operational decisions during thermal remediation. The Operations Team members will review project data and convene mid-morning each workday to review monitoring and process data. The Ops Team Coordinator will provide a summarize the data and make a report of system status at the beginning of each daily Operations Team meeting. The Operations Team will then decide on operational objectives for the next 24-hour period. Once the operational goals for the project are decided, the Operations Team Coordinator will direct the Contractor (SCS Engineers) to implement the decisions of the Operations Team. The decisions and directions provided to the Contractor will be documents in a daily Operations Team Meeting Summary and disseminated to the larger Thermal Remediation Pilot Technical Support Team via e-mail. The daily meeting summary will also be posted to the project wed-site.

The primary role of the Technical Support Team will be to provide technical expertise and advice to the Ops Team. As noted above, members of the Technical Support Team may serve on the Ops Team, at the request of the Project Manager, at times when regular participation is required to resolve reoccurring or consistent issues. For example, if treatment plant breakdowns impact operations, a Process Engineer may be added to the Ops Team to help resolve technical problems, provide advice, and assist in making sound operational decisions. Technical Support Team members will be expected to review project data on the website on a regular basis and stay current regarding on-site developments and progress.

Ops Team Individual Roles and Responsibilities

<u>EPA Remedial Project Manger (RPM) Hanh Gold (Backup: Sylvia Kawabato (EPA):</u> The RPM is the EPA authority for this project. The RPM will approve all recommendations regarding cost and scope variations prior to implementation. The RPM is also responsible for assuring that all functional criteria or the Thermal Remediation Pilot Project are met during conduct of this project. The RPM must be kept informed of progress on a regular basis and will have a decision weigh-in at significant project milestones.

<u>USACE Project Manager (PM) Kathy LeProwse (Backup: Travis Shaw):</u> The PM will maintain specific project management authority throughout the life of the project, and is responsible for overall management and execution of the project to include project quality, cost and schedule. Specific tasks include:

- Providing the project team with funding for each task
- Tracking and reporting to EPA financial expenditures, obligations and schedule
- Ensure that EPA's goals and objectives for the project are achieved.

<u>Site Manager Travis Shaw (Backup: Kathy LeProwse):</u> The Site Manager is responsible for the overall performance of the field work, including adherence to the Sampling and Analysis Plan, change orders, scheduling, liaison with EPA, and sample logging and custody. The Site Manager is responsible for the thorough, smooth and efficient coordination between various on-site contractors, sub-contractors the current treatment plant operators. The Site Manager will also function as the Site Health and Safety Officer, and will be responsible for the safe operation of the field and laboratory teams. He will be responsible for implementation of the Health and Safety Plan for the entire site, review its contents with all personnel, confirm that all personnel have received the required health and safety training, determine personal protection levels, provide necessary personal protective equipment and supplies, and correct any unsafe work practices. To the extent practicable, the Site Manager will coordinate field decisions regarding field activity and thermal operations with the Operations Team.

During fieldwork when the RPM is not present, the Site Manager will be responsible for responding to direct requests from members of the community or others for information on current field activities at the site. A record of such communication shall be maintained and forwarded to the USACE Project Manager and the RPM. When requested by the EPA RPM, the Site Manager will serve as EPA's on-site representative.

Project Hydrogeologist Mike Bailey (Backup: Gorm Heron): The project hydrogeologist will evaluate geologic and hydrogeologic conditions, movement of fluids, heat and contaminants in the subsurface. He will perform and/or oversee modeling activity, aquifer testing, and groundwater extraction or infiltration. The hydrogeologist will also be the lead for data presentation and synthesis of data into GMS.

Monitoring Coordinator Brenda Bachman (Backup: Steve Meyerholtz for thermal/Pilot Area monitoring; Sarah Bates for Treatment Plant monitoring): The Monitoring Coordinator will provide oversight and coordination for all process, compliance and remedy effectiveness monitoring to be conducted by contractors for the Thermal Remediation Pilot Study. She will assist Project Chemist in developing of data quality objectives, selection of analytical methods and laboratories, approval of quality assurance/quality control (QA/QC) procedures, and review of daily field reports.

A 4.1.3 DESIGN/TECHNICAL SUPPORT TEAM

The project support team includes technical personnel and equipment operators involved in data collection, engineering and sampling personnel who provide other support functions.

Project support team members include:

- USACE Process Engineer – Marlowe Dawag
- USACE Instrumentation/Sub-Surface Monitoring – Steve Meyerholtz
- USACE Mechanical Engineer – Sven Lie and Anne Marie Moellenberndt
- USACE Electrical Engineer – Cynthia Masten
- USACE Civil Engineer – Pat Naher
- USACE Industrial Hygienist – Kim Calhoun
- USACE Chemical/Field Support – Sarah Bates
- Off-Site Laboratories:
  - EPA Region 10 Manchester Environmental Laboratory: Gerald Dodo
  - EPA Office of Research and Development: Marta Richards
  - Core Laboratories, Inc.: Jeff Smith
  - PTS Laboratories, Inc.: Richard Young
  - Environmental Resource Associates, Inc.: Joel Holtz
  - Southwest Laboratory of Oklahoma Inc.: Barbara Forrester

- EPA CLP Laboratory: TBD
- SCS Contract Biomonitoring Laboratory: Northwestern Aquatic Sciences
- SCS Contract Air and Water Quality Laboratory: Severn Trent Laboratories
- URS Contract Air Quality Laboratories: Severn Trent Laboratories, Air Toxics, Ltd., and URS air laboratories

- Geoprobe Team: EPA Manchester Lab ESAT Team
- SCS, Inc.: David Roberson
- Pease Construction, Inc.: Loren Pease
- URS Corporation: Ty Griffith
- Sensa, Inc.: Gary Harkins

The project support team will be in daily contact with the Site Manager, or designated technical task manager, when they are working on site. They may be asked to attend technical team meetings to present results or other technical issues, if needed. Off-site laboratories will be contacted by the Site Manager, or designee, as necessary.

A 5.0 PROBLEM DEFINITION AND PROJECT BACKGROUND

A 5.1 Problem Definition

The EPA has selected in-situ thermal technology as the remedy for clean up of the soil and groundwater contamination at the Wyckoff/Eagle Harbor Superfund Site. The purpose of the pilot study falls into two broad categories: a) to assess the likelihood that a full-scale thermal remediation will achieve the cleanup goals for the site; b) to provide information for implementation of the potential full-scale thermal remediation.

Nine primary objectives of the study are described in the Record of Decision (ROD) for the Soil and Groundwater Operable Units (OU's). These nine objectives can be divided into three broad categories: performance assessment, potential impacts of full-scale thermal treatment on the environment and surrounding community, and process monitoring. The specific project objectives described in the ROD are presented below. The pilot study design is based on meeting these objectives.

Performance Assessment Objectives

- Demonstrate that thermal remediation technologies will remove substantially all mobile NAPL from the Pilot Study treatment area.
- Demonstrate that the post-thermal treatment concentrations of NAPL constituents dissolved in groundwater that move from the site to Eagle Harbor and Puget Sound will

not exceed marine water quality criteria, surface water quality and sediment standards at the mud line.

- Demonstrate that surface soil (0 to 15 ft) concentrations within the Pilot Study area attain MTCA Method B cleanup levels.

Community and Environmental Impacts of Full-Scale Thermal Remediation Objectives

- Determine the potential impacts (noise, air emissions, lower aquifer and odors) of full-scale thermal treatment to the surrounding community.

- Evaluate the possible adverse effects that full scale thermal treatment may have to Eagle Harbor and Puget Sound near shore marine habitats.

Process Objectives

- Evaluate operational approaches to thermal remediation that may impact the removal of NAPL, such as steam movement and recovery of NAPL from the aquitard.

- Evaluate treatment plant performance during the Pilot Study to allow optimization of operations and monitoring mass balance of contaminant removal.

- Evaluate microbial populations before and after thermal treatment to assist in determining long-term contaminant destruction.

- Evaluate contaminant oxidation rates during thermal treatment to assist in mass balance calculations.

A 5.2 Project Background

The Wyckoff/Eagle Harbor Superfund site is located on Bainbridge Island, Washington, on the southern shoreline near the entrance to Eagle Harbor (Figure 2). The site has been divided into four operable units (OUs):

- Wyckoff Soil OU: surface and subsurface soil extending to the maximum elevation of the water table (or other fluid boundary)

- Wyckoff Groundwater OU: subsurface soil and groundwater beneath the maximum elevation of the water table (or other fluid boundary) extending to the sheet pile containment wall.

- West Harbor OU: intertidal and subtidal surface sediments located within the West Harbor OU boundary

- East Harbor OU: intertidal and subtidal surface sediments located within the East Harbor OU boundary

The focus of Thermal Remediation Pilot Study is the Pilot Study area in the Former Process Area within the Soil and Groundwater OUs. Figure 3 is a site plan of the Former Process area. The Pilot Study area comprises approximately 12% of the surface area of the Former Process area. The entire Wyckoff property occupies approximately 57 acres (about 18 of which encompass the Soil OU), including a spit with about 0.8 miles of shoreline extending northward into Eagle Harbor. The spit has been extended and filled at least twice prior to the 1950s, and was the location of wood treatment activities that have caused the current soil and groundwater contamination.

The Wyckoff Soil and Groundwater OUs occupy a relatively flat lowland and intertidal area bounded by a densely vegetated bluff on the south. The lowland area has an average elevation of approximately 10 feet NGVD while the hillside area rises to elevations above 200 feet. A small stream flows north from the hills above the western arm of the property into a culvert that discharges into Eagle Harbor. The north and west portions of the spit are bounded by Eagle Harbor, and Puget Sound abuts the eastern margin of the spit.

A 5.2.1 SITE HISTORY

Prior to 1904, the Wyckoff property was owned by a sand mining operation and a brickyard. From 1904 through 1988, the site was used for the treatment of wood products (e.g., railroad ties and trestles, telephone poles, pilings, docks and piers) by a succession of owners and companies. Chemicals used at the site include creosote, pentachlorophenol (PCP), solvents, gasoline, antifreeze, fuel, waste oil and lubricants. These chemicals were stored in above-ground storage tanks, conveyed through above- and below-ground piping, disposed in sumps, spilled and buried on site.

EPA began an investigation of the property in 1971, and the site was subsequently placed on the National Priority List (in 1987). In 1988, the Wyckoff Company ceased all operations on the property. In 1993, EPA assumed management of the Soil and Groundwater OUs, and in 1994 the assets of the former Wyckoff Company (now Pacific Sound Resources) were placed into an environmental trust.

All wood-treatment structures in the lowland portion of the site, including buildings, foundations, tanks, pipelines and sumps, were removed between 1988 and 1997. The West Dock was removed in December 1998. A groundwater treatment plant, monitoring and extraction wells, and a conveyance piping system for groundwater remediation are in place and in use. Over the last 12 months, infrastructure to support the Thermal Remediation Pilot Study has been constructed. Elements of construction include:

- Steam injection and extractions wells.
- Water supply well.
- Subsurface instrumentation.
- Boiler building and tank slabs.

- Underground utilities trenches for electrical power, water lines, and contaminated fluid conveyance piping.
- Vapor cap and vapor collection piping within the Pilot Study Area.
- Improvements in the site's electrical service.
- Installation of the steam generation and injection system.
- Installation of the water and vapor extraction system.
- Modifications to the existing groundwater treatment and processing systems including replacement of the existing depurator with a new Dissolved Air Flotation (DAF) system.
- Above ground mechanical and boiler equipment installation.
- Installation of a fuel storage and supply system.
- Installation of the water supply well pump and associated piping.

A 5.2.2 PREVIOUS INVESTIGATIONS AND REMEDIATION EFFORTS

EPA began investigating the Wyckoff property in 1971. The RI report (CH2M HILL 1997a) contains a summary of the investigations and studies conducted at the site through 1997. During the 1970s, efforts were made to address oil seepage on beaches adjacent to the plant through site inspections and recommendations. During the 1980s, at least five investigations of groundwater, soil, seeps and sediments were conducted at the site to characterize the extent of contamination. Investigations continued in the 1990s and have included a focused RI/FS (CH2M HILL 1994) for the Groundwater OU to provide administrative justification for interim removal actions and a full RI/FS (CH2M HILL 1997a and 1997b).

Source control and remediation activities have been conducted at the site since 1981 to mitigate actual or potential threats to human health or the environment. Table 1-3 of the RI report provides a list of these activities. They have included removal and offsite disposal of structures including buildings, sumps and retorts; storage tanks; pipelines; asbestos and selected docks and pilings. A groundwater extraction and treatment system has been operational since 1990 to minimize further releases and recover as much NAPL as possible. New wells have been installed for monitoring and extraction purposes and approximately 19 deteriorated wells have been abandoned.

Geotechnical investigations for design of a slurry wall began in February 1997, for the purpose of establishing the depth and continuity of the aquitard along the proposed alignment, and to collect soil data required for design of the wall. Initially, soil borings were drilled on 50 to 100-foot centers along the alignment proposed in the FS report (CH2M HILL 1997b). Alignment changes were made to accommodate anticipated excavation equipment limitations, and the area of investigation was gradually extended during the drilling program as additional NAPL was discovered in the subsurface. Eventually a total of 43 auger borings were drilled, sampled and abandoned. Large amounts of NAPL were detected along the shoreline areas, indicating that part of the slurry wall should extend offshore; consequently an additional 11 soil borings were drilled in January 1998. Blow counts were recorded in all borings for a 3-inch split-spoon driven with a 300-pound hammer, and samples from all of the borings were tested for gradation and Atterberg limits. Samples from the vadose zone were also tested for moisture content, and offshore samples were tested for NAPL saturation and density, and pore water salinity and density.

New and promising developments in the use of thermal remediation technologies at NAPL contaminated sites prompted EPA to delay the slurry wall design effort and begin evaluating thermal techniques. CH2M Hill produced a comparative analysis of thermal technologies and containment remedies for the site that concluded that thermal technologies could provide an effective remedial option for the Wyckoff site. EPA tasked USACE to conduct a NAPL Field Exploration in the summer of 1999 to obtain site-specific data to complete the evaluation. The NAPL Field Exploration used Site Characterization and Analysis Pentetrometer System (SCAPS) equipped with a Laser Induced Fluorescence (LIF) probe to identify NAPL zones on the upland portion of the site and estimate the extent of NAPL contamination. Physical and chemical data was also collected using traditional drilling methods and existing monitoring wells to address specific thermal remediation design issues. In addition, a Geoprobe direct push rig was mobilized to the intertidal area adjacent to the Wyckoff facility to determine the depth of the underlying confining layer to support the design of a sheet pile containment wall. The Corps has also investigated the horizontal and vertical extent of contamination of the western side of the Wyckoff site to obtain design level data for a soil removal plan.

In 1999, USACE conducted a NAPL Field Exploration on behalf of EPA to evaluate the potential for thermal remediation at the site and obtain data for the design of a sheet pile containment wall. Construction of the sheet pile containment wall to prevent contaminant migration from the Wyckoff site into Eagle Harbor and Puget Sound was completed in February 2001. A smaller sheet pile wall was installed inside the outer containment wall to provide a site for the Thermal Remediation Pilot Study.

A 6.0 PROJECT DESCRIPTION

EPA is evaluating thermal technologies by conducting an onsite pilot study to enhance the recovery of creosote from the upper groundwater aquifer. In the interim, a sheet pile barrier has been constructed to prevent movement of contaminants beyond the site boundaries. If the Thermal Remediation Pilot Study is not successful in demonstrating the effectiveness of thermal treatment if the full scale system is not implemented, a "containment" remedy is now partially in place. This remedy would include the existing sheet pile wall that surrounds the contaminants in the Former Process Area, a replacement groundwater pump-and-treat system to maintain the water level within the barrier wall and a soil cap to isolate surface soils in the Former Process Area.

The currently implemented Thermal Remediation Pilot Study relies on steam injection to deliver heat underground in order to mobilize and enhance the recovery of contaminants. Heating the contaminated zone enhances the cleanup of difficult-to-remediate contaminants by:

Reducing the viscosity of the contaminants to enhance extraction

Increasing the contaminant vapor pressures to enhance volatilization

Increasing contaminant solubilities to enhance dissolution

Increasing microbial degradation and natural oxidation rates

Wells are placed within and surrounding the contaminated zone to collect the contaminants that are easier to extract. The extracted water, vapor, and NAPL are either treated on-site or disposed of off-site. Not all NAPL is expected to become mobilized by the delivery of heat. Heated areas of the site are expected, however, to remain at high temperatures for several months. These high temperatures will continue to enhance the volatilization and dissolution rates of the residual, relatively immobile NAPL. Ongoing extraction of contaminants would continue for a period of time after "steaming" is stopped.

Thermal effects will also contribute to enhanced rates of microbial degradation and oxidation (contaminant breakdown) through hydrous/pyrolysis/oxidation (HPO, or oxidation) of contaminant constituents, resulting in non-toxic compounds.

Thermal remediation may be capable of remediating contaminants that occur in both the unsaturated and saturated zones. Therefore, under the preferred alternative, contaminated soil (approximately 30,000 cubic yards) from the Former Log Storage/Peeler Area and the Well CW01 area have been excavated and placed within the Former Process Area to be remediated by steam injection if EPA pursues full-scale thermal remediation. In the event that full-scale thermal remediation is not implemented, the surface soils within the Former Process area will be capped as part of the containment remedy. The excavated areas of the Former Log Storage/Peeler Area were backfilled with clean soil. The final grade of the CW01 area was contoured to restore the natural slope of the hillside excavation area.

The following list indicates the activities included in the project and their approximate duration:

- Pilot plant start up and commissioning: 09/01/02 to 09/30/02
- Active steam injection: 10/01/02 to 03/30/03
- Active liquid/vapor extraction during cool down with performance monitoring: 04/01/03 to 09/30/03
- EPA evaluation and decision on full-scale operations: fall 2003
- Groundwater pump and treat with ongoing monitoring: ongoing from 09/30/03

If the Thermal Remediation Pilot Project is not successful in demonstrating the effectiveness of thermal treatment and if the full scale system is not implemented, a "containment" remedy is now partially in place: a sheet pile barrier has been constructed to prevent movement of contaminants beyond the site boundaries. This remedy would include the existing sheet pile wall that surrounds the contaminants in the Former Process Area, a replacement groundwater pump-and-treat system to maintain the water level within the barrier wall and a soil cap to isolate surface soils in the Former Process Area.

A 7.0 QUALITY OBJECTIVES AND CRITERIA FOR MEASUREMENT DATA

The design of the Pilot Study monitoring program attempts to follow the Corps of Engineers Technical Project Planning Process (TPP) as described in EM 200-1-2 (August, 1998). The TPP provides a framework for the systematic identification of project objectives and helps ensure required types, quantity and quality of data are obtained to meet the project objectives. The TPP is also consistent with EPA's 7-Step Data Quality Objective Process.

The TPP began with the identification of project objectives (Final Design Analysis (DA) Tables 2.1 and 2.2, Appendix E) (USACE 2001). Project objectives were also classified by data user category and data classification (DA Table 2.3, Appendix E). Next, data users were identified by category (DA Table 2.4, Appendix E). For the technical planning process to succeed, it is crucial that data users provided input to monitoring plan designers to ensure that project objectives and data requirements met identified objectives.

Data quality objective worksheets were then prepared for each data user perspective. These worksheets compile data type, data use, specific project objectives met by the data and required sensitivity (if determined). At this stage of the project, only remedy effectiveness and compliance perspective worksheets have been developed. As the project progresses, it will become more important to identify data quality worksheets for both risk and responsibility perspectives.

A 8.0 SPECIAL TRAINING/CERTIFICATION

A 8.1 Hazardous Waste Site Operations Training

All site personnel will meet the Hazardous Waste Site Operations Training (HAZWOPER) and other requirements of 29 CFR 1910.120(e), including:

- Forty hours or initial off-site training or its recognized equivalent;
- Eight hours of annual refresher training for all personnel (as required);
- Eight hours of supervisor training for personnel serving as Site Health and Safety Officers;
- Three days of work activity under the supervision of a trained and experienced supervisor.

All site personnel will participate in medical surveillance programs that meet the requirements of 29 CFR 1910.120(f).

Prior to the start of operations at the site, the Site Health and Safety Officer will conduct a site safety briefing, which will include all personnel involved in site operations. All site personnel, including subcontractor personnel, are to attend the briefings and sign the briefing form. Subsequent site safety briefings will be conducted at least weekly, or whenever there is a change in task or significant change in task location. Briefings will also be conducted whenever new personnel report to the site. For each briefing, the Site Health and Safety Officer will complete a site safety briefing form that will be kept in the project file.

A 8.2 Plant Operator Experience

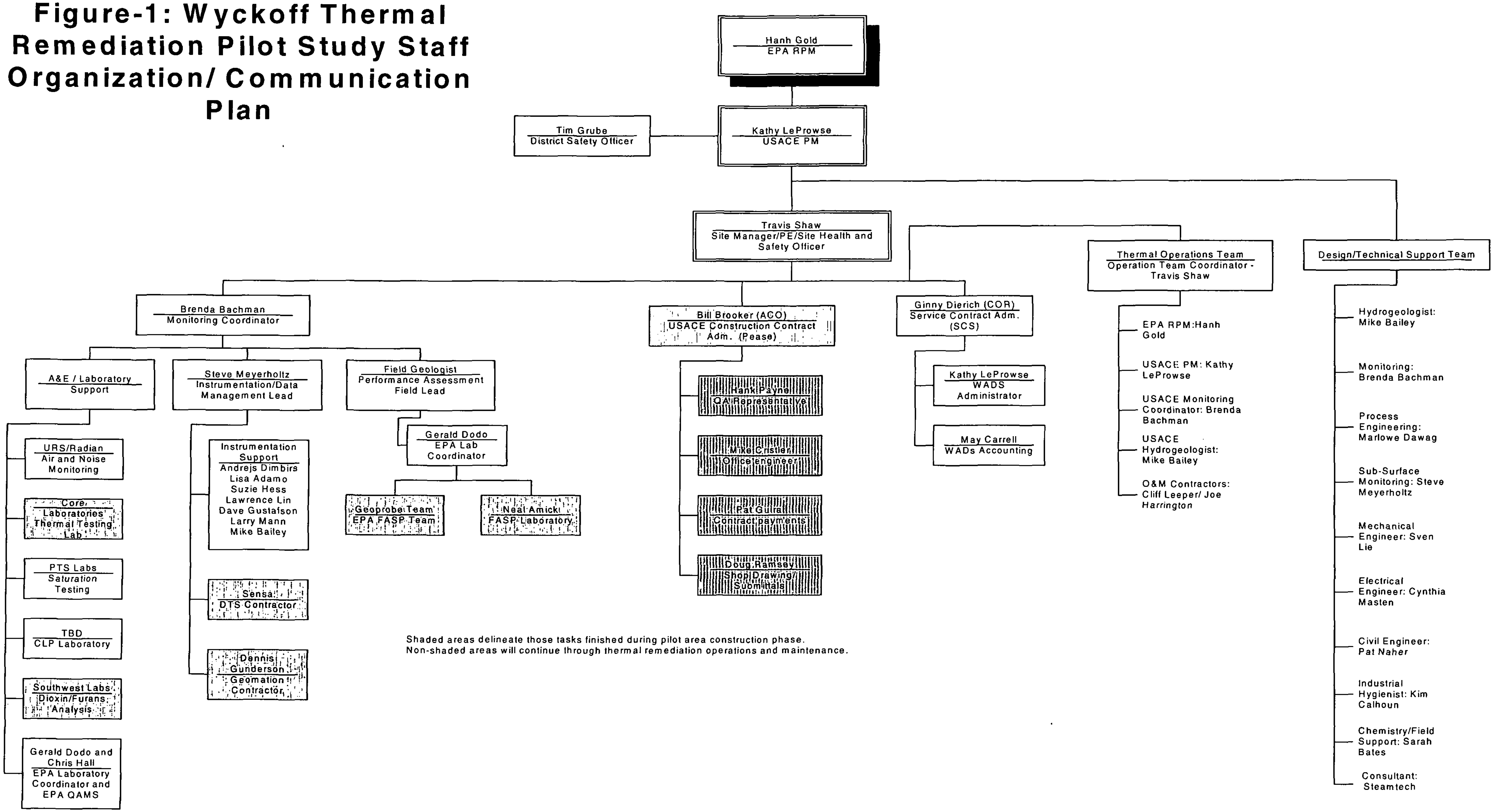
The plant operators will meet the following minimum qualifications:

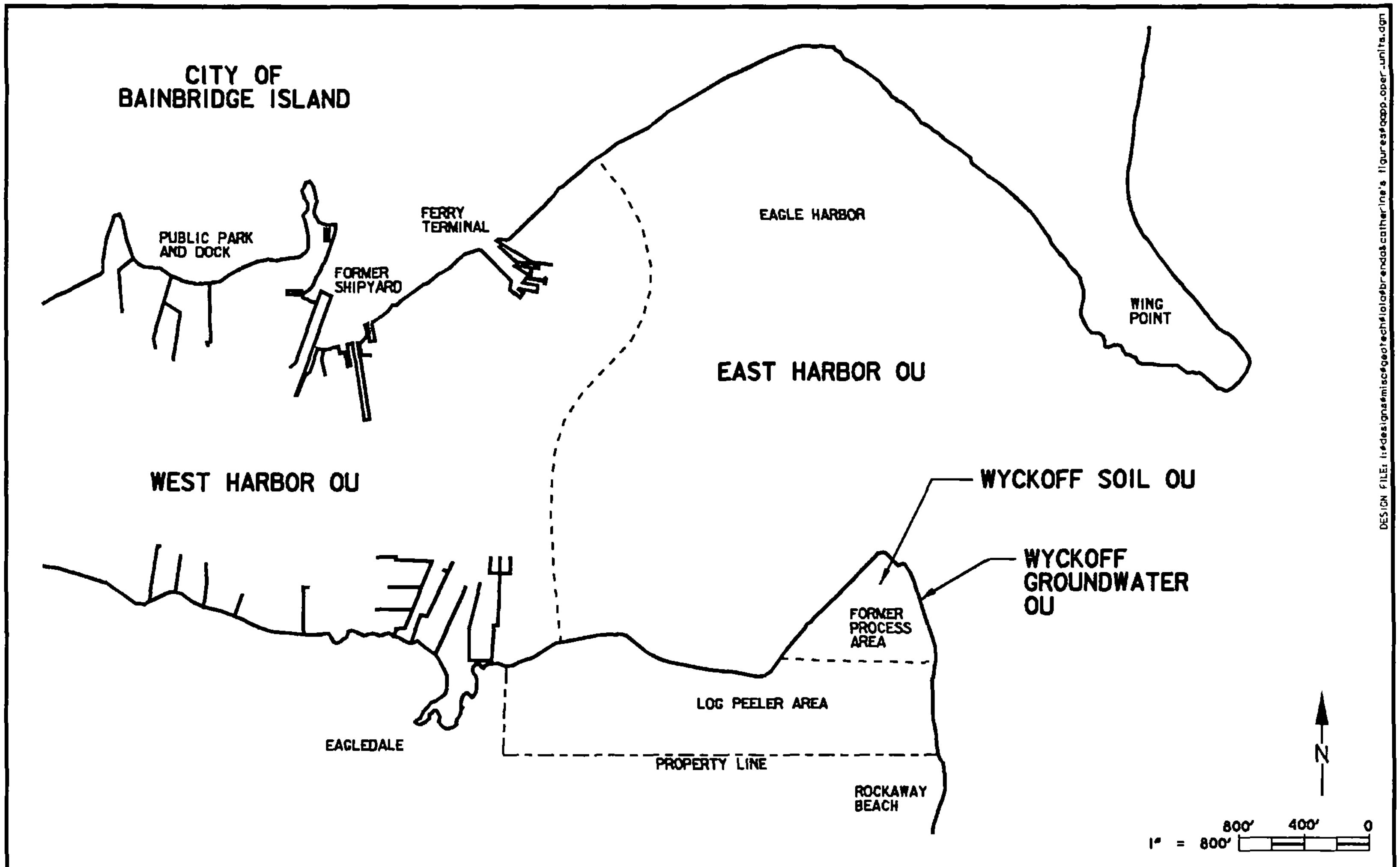
- Have the ability to read technical specifications and drawings, and a minimum of five years experience in operation and maintenance of wastewater/groundwater treatment plants, contaminant extraction systems, vacuum systems and/or vapor treatment systems.
- Hazardous Waste Site Operations Training (above).
- Be trained or experience in collection, preservation, and general handling of water samples.

A 9.0 DOCUMENTS AND RECORDS

Field activities will be documented in draft and final versions in technical memorandum format. The memorandum will include a discussion of field work; results of chemical and physical soil tests, results of the upper aquifer pumping test and results of groundwater sampling conducted during the water supply well installation. Field notes, calculations, field forms, analysis results and resultant interpretations will be included. This memorandum will also include an analysis of the results in relation to the purpose and objectives of the field activities. A review conference will be held to discuss the memorandum and recommendations. Formal, written responses to EPA and project team review comments will be prepared and incorporated into the final reports as necessary.

Figure-1: Wyckoff Thermal Remediation Pilot Study Staff Organization/ Communication Plan



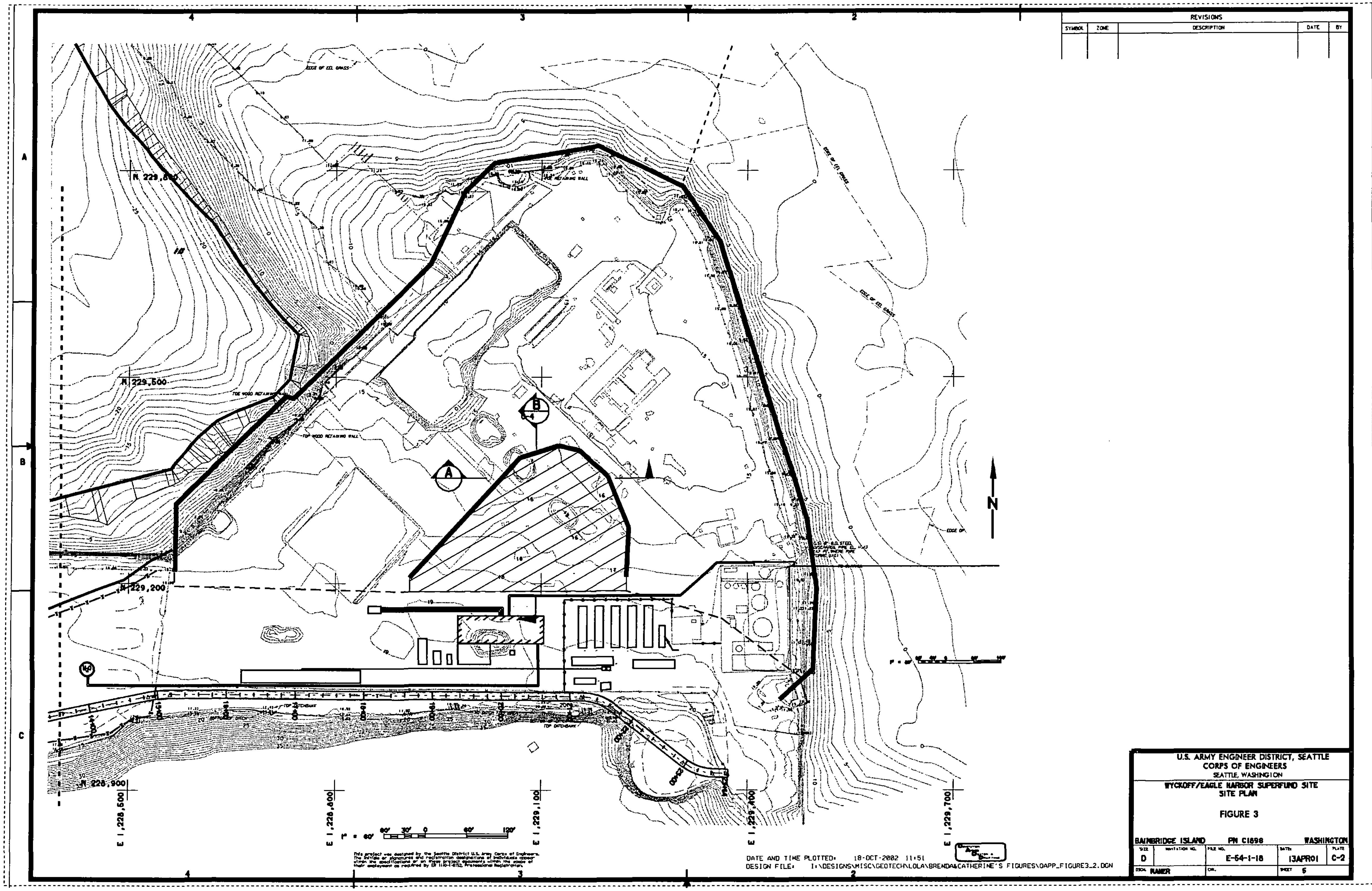


US Army Corps
of Engineers
Seattle District

FIGURE 2
LOCATIONS OF OPERABLE UNITS AT
WYCKOFF/EAGLE HARBOR SUPERFUND SITE

QAPP
THERMAL REMEDIATION
PILOT PROJECT

WYCKOFF/EAGLE HARBOR SUPERFUND SITE
BAINBRIDGE ISLAND, WASHINGTON


REVISIONS
SYMBOL
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DESCRIPTION
DATE
BY
N 229,800
N 229,500
N 229,200
N 228,900
E 1,228,500
E 1,228,800
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E 1,229,700
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DATE AND TIME PLOTTED: 18-OCT-2002 11:51
DESIGN FILE: I:\DESIGNS\MISC\GEOTECH\LOLA\BRENDA&CATHERINE'S FIGURES\OAPP_FIGURE3_2.DGN
U.S. ARMY ENGINEER DISTRICT, SEATTLE
CORPS OF ENGINEERS
SEATTLE, WASHINGTON
WYCKOFF/EAGLE HARBOR SUPERFUND SITE
SITE PLAN
FIGURE 3
BAINBRIDGE ISLAND
PN C1698
WASHINGTON
SIZE
D
FILE NO.
E-64-1-18
DATE:
13APR01
PLATE
C-2
SHEET
5

B DATA GENERATION AND ACQUISITION

B 1.0 SAMPLING PROCESS DESIGN

The sampling process design is included in the Field Sampling Plan (FSP) for the monitoring program.

B 2.0 SAMPLING METHODS

Sampling methods are included in the FSP for the monitoring program.

B 3.0 SAMPLE HANDLING AND CUSTODY

Sample handling and custody procedures are included in the FSP for the monitoring program.

B 4.0 ANALYTICAL METHODS

Data will be collected using field portable instruments and off-site fixed laboratories. Specific methods to be used by field and laboratory staff when taking field measurements or analyzing samples of air, groundwater, and waste materials are presented in this section.

B 4.1 Field Measurement Methods

This section describes the field measurement methods to be used by operations staff at the site. Field instruments, measurement parameters, and measurement quality indicators are summarized in Tables B-1 through B-6. Methods and quality assurance requirements are included for field measurements taken from instrumentation built into the treatment system (e.g., thermocouples, pressure transducers, and stroke counters) as well as for field measurements taken from portable instruments (e.g., pH meters and water level indicators).

Measurement methods generally follow the manufacturer's directions and are described in detail in the Field Sampling Plan.

B 4.2 Laboratory Analytical Methods

This section describes the analytical methods to be used by the on-site Groundwater Treatment Plant (GWTP) laboratory as well as the off-site fixed laboratories. The analytical methods and associated quality assurance/quality control procedures were selected based on consideration of the project objectives. The analytical methods, calibration procedures, and QC measurements and criteria are based on current analytical protocols in the following:

- U.S. EPA, Test Methods for Evaluating Solid Waste, Third Edition. SW-846, March 1986.
- U.S. EPA, Methods for Chemical Analysis of Water and Wastes. EPA-600/4-79-020. 1983.
- Standard Methods for Examination of Water and Wastewater, 16th Edition, APHA, 1985.

Target analytes, analytical methods, sensitivity requirements, method reporting limits, and measurement quality objectives for all types of samples collected for laboratory analysis are summarized in the Tables B-7 through B-15. Samples will be analyzed by the following laboratories:

- On-site GWTP Laboratory
- EPA Region 10 Manchester Environmental Laboratory
- EPA-designated CLP laboratory (to be determined)
- SCS Engineers, Inc. contracted laboratories:
  - Severn Trent Laboratories (STL) of Tacoma, Washington
  - Northwestern Aquatic Sciences Laboratory of Newport, Oregon
- URS Corporation contracted laboratories:
  - Air Toxics, Ltd., of Folsom, California
  - Severn Trent Laboratories (STL) of Tacoma, Washington
  - URS Corporation air laboratories in Sacramento, California and Austin, Texas

B 4.3 Analytical Method Detection Limits, Quantitation Limits, and Reporting Limits

Sensitivity requirements for all methods and matrices are driven by the project objectives. The field and laboratory methods selected provide data of sufficient sensitivity to allow the project team to evaluate site conditions and meet the monitoring requirements. Method detection limits (MDL), quantitation limit (MQL), and reporting limits (MRL) are defined below.

Method Detection Limit

The MDL is the minimum concentration of a substance that can be measured and reported with 99 percent confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte (Appendix B of 40 CFR 136). Method detection limit studies have been performed by the laboratory and are acceptable for this project.

Method Quantitation Limit

The MQL represents the value for which the laboratory has demonstrated the ability to reliably quantitate target analytes within a prescribed performance criteria for the method performed. Operationally, it is equivalent to the concentration of the lowest calibration standard in the initial calibration curve.

Method Reporting Limit

The MRL is a threshold value below which the laboratory reports a result of non-detected. It may be based on project-specific concentrations of concern, regulatory action levels, or sensitivity capability of method and instrument. The MRLs are adjusted based on the sample matrix and any necessary sample dilutions. Operationally, it is equivalent to the MQL adjusted based on the sample matrix and any necessary dilutions.

B 5.0 QUALITY CONTROL

The overall quality assurance objectives for field sampling and laboratory analysis are to produce data of known and appropriate quality to support the project objectives. Appropriate procedures and quality control checks will be used so that known and acceptable levels of accuracy and precision are maintained for each data set. Field quality control and laboratory quality control samples will be employed to evaluate data quality. Quality control samples are controlled samples introduced into the analysis stream whose results are used to review data quality and to calculate the accuracy and precision of the chemical analysis program. The purpose of each type of quality control sample, collection and analysis frequency, and evaluation criteria are described in this section. Collection and analysis frequency for field quality control samples are summarized in Table B-16 through Table B-20. Laboratory quality control samples as described in the referenced methods will be followed.

Methods for establishing the quality of field and laboratory measurements will generally conform with USEPA SW-846 quality control requirements and quality criteria (when applicable). All quality control measurements and data assessment for this project will be conducted on samples from and within batches of samples from this project alone; in other words, no "other project" samples will be used with samples from this project for assessment of data quality.

B 5.1 Field Quality Control Samples

Field quality control checks are accomplished through the analysis of controlled samples that are introduced to the laboratory from the field. Rinsate and field blanks, field duplicates and matrix spike/matrix spike duplicate (MS/MSD) samples will be collected and submitted to the laboratory to provide a means of assessing the quality of data resulting from the field sampling program. Field quality control samples will be selected by the sampling team and designated in the field logbook, as appropriate.

Rinsate and Field Blank Samples

Rinsate blanks are often collected to determine the potential for cross-contamination of samples during collection. However, it has been determined that neither rinsate nor field blank samples will need to be analyzed during the operation of the pilot remediation and groundwater treatment system. Field blanks are considered unnecessary because volatile organic compounds will not be analyzed. Rinsate samples are not considered necessary because of the sampling methods (i.e. the use dedicated data collection equipment) being employed.

Field Duplicate Samples

Field duplicate samples will be used to check for sampling reproducibility. One field duplicate sample of the treatment plant effluent (SP-11) will be collected and submitted for analysis every four weeks. One field duplicate will also be submitted with every groundwater sampling round.. No field duplicates will be collected for process monitoring samples. Control limits for field duplicate precision are 30 percent relative percent difference (RPD).

Field duplicates will be submitted blind to the laboratories, with sample numbers that are indistinguishable from primary samples.

Matrix Spike/Matrix Spike Duplicate Samples

Matrix spikes are used to assess sample matrix interferences and analytical errors, as well as to measure the accuracy of the analysis. Known concentrations of analytes are added to environmental samples; the MS/MSD is then processed through the entire analytical procedure and the recovery of the analytes calculated. Results are expressed as percent recovery of the known spiked amount. MS/MSD pairs will be collected and analyzed at a rate of one pair every four weeks for treatment plant effluent compliance monitoring and one per sampling round for groundwater monitoring. MS/MSDs will only be collected for PAH and PCP samples.

Because MS/MSD samples measure the matrix interference of a specific matrix, only MS/MSD samples from this investigation will be analyzed, and not samples from other projects. The MS/MSD samples will be analyzed for the same parameters as the associated field samples in the same analytical batch.

Samples for use by the laboratory as MS or MS duplicates will be identified on the chain-of-custody form and additional sample volumes must be provided to the laboratory.

Performance Evaluation Samples

Performance evaluation (PE) samples are submitted to the laboratory and analyzed for the purpose of evaluating the performance of the measurement or analytical procedures used by the laboratory. Performance evaluation samples will be analyzed along with GWTP process samples.

B 5.2 Laboratory Quality Control Samples

Laboratory quality control checks are accomplished through analyzing initial and continuing calibration samples, method blanks, surrogate spikes, laboratory control samples (LCS), and laboratory duplicate samples. Not all of these quality control samples will be required for all methods. Typically, these samples are not required for non-SW-846 methods such as ASTM methods.

Initial and Continuing Calibration Samples

Calibration of laboratory owned and operated equipment will be in accordance with the laboratory quality assurance/quality control plan and the methods referenced in Tables B-7 through B-15.

Method Blanks

Method blanks are used to check for laboratory contamination and instrument bias. Laboratory method blanks will be analyzed at a minimum frequency of 5 percent or one per analytical batch for all chemical parameter groups.

Quality control criteria require that no contaminants be detected in the blank(s) above the MQL. If a chemical is detected, the action taken will follow the methods referenced in Tables B-7 through B-15. Blank samples will be analyzed for the same parameters as the associated field samples.

Surrogate Spikes

Accuracy of an analytical measurement is evaluated by using surrogate spikes. Surrogate compounds are compounds not expected to be found in environmental samples; however, they are chemically similar to several compounds analyzed in the methods and behave similarly in extracting solvents. Samples for organics analysis will be spiked with surrogate compounds consistent with the methods referenced in Tables B-7 through B-15.

Percent recovery of surrogates is calculated concurrently with the analytes of interest. Since sample characteristics will affect the percent recovery, the percent recovery is a measure of accuracy of the overall analytical method on each individual sample.

Laboratory Control Samples

Laboratory control samples (LCS) are used to monitor the laboratory's day-to-day performance of routine analytical methods, independent of matrix effects. The LCS are prepared by spiking reagent water or silica sand with standard solutions prepared independently of those used in establishing instrument calibration. The LCS are extracted and analyzed with each batch of samples. Results are compared on a per-batch basis to established control limits and are used to evaluate laboratory performance for precision and accuracy. Laboratory control samples may also be used to identify any background interference or contamination of the analytical system that may lead to the reporting of elevated concentration levels or false positive measurements.

Laboratory Duplicate Samples

Precision of the analytical system is evaluated by using laboratory duplicates. Laboratory duplicates are two portions of a single homogeneous sample analyzed for the same parameter. Laboratory duplicates will follow requirements of the methods referenced in Tables B-7 through B-15.

B 5.3 Analytical Data Quality Indicators

The data quality indicators presented in this section are precision, accuracy (bias), representativeness, comparability, completeness, and sensitivity. Project-specific control limits for these indicators are presented in Tables B-1 through B-15.

Precision

Precision is defined as the degree of agreement between or among independent, similar, or repeated measures. Precision is expressed in terms of analytical variability. For this project, analytical variability will be measured as the relative percent difference (RPD) or coefficient of variation between results for laboratory duplicate pairs. Monitoring variability will be measured by analysis of field duplicate pairs.

Precision will be calculated as the RPD as follows:

$$\%RPD_i = \frac{2|O_i - D_i|}{(O_i + D_i)} \times 100\%$$

where:

$\%RPD_i$	=	Relative percent difference for compound *i*
O_i	=	Value of compound *i* in original sample
D_i	=	Value of compound *i* in duplicate sample

The resultant RPD will be compared to acceptance criteria and deviations from specified limits reported. If the objective criteria are not met, the laboratory will supply a justification of why the acceptability limits were exceeded and implement the appropriate corrective actions. The RPD will be reviewed during data quality review, and deviations from the specified limits will be noted and the effect on reported data commented upon by the data reviewer.

Accuracy

Accuracy is the amount of agreement between a measured value and the true value. It will be measured as the percent recovery of matrix spike samples. Additional potential bias will be quantified by the analysis of blank samples (e.g., method, field, and rinsate blanks).

Accuracy shall be calculated as percent recovery of target analytes as follows:

$$\%R_i = (Y_i \div X_i) \times 100\%$$

where:

$\%R_i$	=	percent recovery for compound *i*
Y_i	=	measured analyte concentration in sample *i*
(measured - original sample concentration)		
X_i	=	known analyte concentration in sample *i*

The resultant percent recoveries will be compared to acceptance criteria and deviations from specified limits will be reported. If the objective criteria are not met, the laboratory will supply a justification of why the acceptability limits were exceeded and implement the appropriate corrective actions. Percent recoveries will be reviewed during data quality review, and deviations from the specified limits will be noted and the effect on reported data commented upon by the data reviewer.

Representativeness

Representativeness is the degree to which sample results represent the system under study. This component is generally considered during the design phase of a program. This program will use the results of all analyses to evaluate the data in terms of its intended use.

Comparability

Comparability is the degree to which data from one study can be compared with data from other similar studies, reference values (such as background), reference materials, and screening values. This goal will be achieved through using standard techniques to collect and analyze representative samples and reporting analytical results in appropriate units. Comparability will be evaluated during data quality assurance review.

Completeness

Completeness for usable data is defined as the percentage of usable data out of the total amount of planned data. The target goal for completeness shall be 98 percent for all data. Completeness for quality data shall be 95 percent for each individual analytical method. Quality data are data obtained in a sample batch for which all QC criteria were met. Completeness will be calculated as follows:

$$\%C = \frac{A}{I} x100\%$$

where:

$\%C$	=	Percent completeness (analytical)
A	=	Actual number of samples collected/valid analyses obtained
I	=	Intended number of samples/analyses requested

Non-valid data (i.e., data qualified as "R" rejected) will be identified during the QA review.

Sensitivity

The sensitivity of the analytical methods (i.e., method reporting limits) identified for this project are sufficient to allow comparison of project results to decision criteria. Analytical method reporting limits for all requested analytes are listed in Tables B-1 through B-15.

B 6.0 EQUIPMENT MAINTENANCE

Field and laboratory instrumentation will be examined and tested prior to being put into service and will be maintained according to the manufacturer's instructions. Sampling personnel will maintain a supply of typical maintenance replacement items available in the field to help prevent downtime because of equipment malfunctions. Examples of typical equipment maintenance items may include but not be limited to filters, tubing, fittings, sample containers, and calibration standards.

Field equipment will be serviced before the project is initiated and at regular intervals during the project as required by the manufacturer's instructions. All laboratory instruments will be maintained as specified in the project laboratory's QA plan and according to manufacturers' instructions. Manufacturer's instructions will be followed for any additional equipment that is required for the project.

B 7.0 INSTRUMENT CALIBRATION

Field and laboratory instrument calibration will be conducted in accordance with the QC requirements identified in the manufacturers' instructions and the laboratory SOPs. General requirements are discussed below.

B 7.1 Field Instruments

All calibration procedures and measurements will be made in accordance with manufacturers' specifications and standard operating procedures. Field instruments will be checked and calibrated prior to their use, and batteries will be charged and checked daily where applicable. Instrument calibrations will be performed at the beginning of each work day and checked and recalibrated if necessary through the course of the day according to manufacturer's specifications or if deemed necessary by sampling personnel. Special attention will be given to parameters that may drift with change in ambient temperature (e.g. dissolved oxygen).

Equipment that fails calibration and/or becomes otherwise inoperable will be removed from service and segregated to prevent inadvertent use. Such equipment will be properly tagged to indicate that it should not be used until repaired. Equipment that cannot be repaired or recalibrated will be replaced.

All documentation pertinent to the calibration and/or maintenance of field equipment will be maintained in an active field logbook. Logbook entries regarding the status of field equipment will contain, but will not necessarily be limited to, the following information:

- Date and time of calibration
- Name of person conducting calibration
- Type of equipment being serviced and identification (make, model and serial number)
- Reference standard used for calibration (such as pH of buffer solutions)
- Calibration and/or maintenance procedure used
- Other pertinent information

B 7.2 Laboratory Instruments

As stated in USEPA SW-846 and applicable laboratory SOPs, calibration of all analytical instrumentation is required to ensure that the analytical system is operating correctly and functioning at the sensitivity required to meet project objectives. Each instrument will be calibrated with standard solutions appropriate to the instrument and analytical method, in accordance with the methodology specified and at the QC frequency specified in the laboratory SOPs.

The calibration and maintenance history of the fixed laboratory instrumentation is an important aspect of the project's overall QA/QC program. As such, all initial and continuing calibration procedures will be implemented by trained personnel following the manufacturer's instructions and in accordance with applicable EPA protocols to ensure the equipment is functioning within the tolerances established by the manufacturer and the method-specific analytical requirements.

B 7.3 Standard Solutions

A critical element in the generation of quality data is the purity/quality and traceability of the standard solutions and reagents used in the analytical operations. To ensure the highest purity possible, all primary reference standards and standard solutions will be obtained from a reliable commercial source. The laboratories will maintain a written record of the supplier, lot number, purity/concentration, receipt/preparation date, preparer's name, method of preparation, expiration date, and all other pertinent information for all standards, standard solutions, and individual standard preparation logs.

Standard solutions will be validated prior to use. Validation procedures can range from a check for chromatographic purity to verification of the concentration of the standard solution using another standard solution prepared at a different time or obtained from a different source. Stock and working standard solutions will be checked regularly for signs of deterioration, such as discoloration, formation of precipitates, or change of concentration. Care will be exercised in the proper storage and handling of standard solutions, and all containers will be labeled as to compound, concentration, solvent, expiration date, and preparation data (initials of preparer/date of preparation). Reagents will be examined for purity by subjecting an aliquot or subsample to the corresponding analytical method as well.

B 8.0 DATA MANAGEMENT

B 8.1 Data Reduction

The laboratory will perform in-house analytical data reduction under the direction of the laboratory QA manager. Data reduction will be conducted as follows:

- Raw data produced by the analyst will be processed and reviewed for attainment of QC criteria as outlined in this QAPP and/or established EPA methods, for overall reasonableness, and for transcription or calculations errors.

- After entry into the Laboratory Information Management System (LIMS), a computerized report will be generated and sent to the laboratory QA data reviewer.

- The laboratory QA data reviewer will decide whether any sample reanalysis is required and the laboratory project manager will discuss reanalysis with the Project Manager within 48 hours of the corrective action.

- Upon acceptance of the preliminary reports by the laboratory QA data reviewer, final reports will be generated. Final data reports will be available within 30 calendar days of sample submittal.

Laboratory data reduction procedures will be those specified in EPA SW-846 (3rd edition) and those described in the laboratory SOPs. The data reduction steps will be documented, signed, and dated by the analyst.

The laboratories will maintain detailed procedures for laboratory record keeping in order to support the validity of all analytical work. Each data report package will contain the laboratories' written certification that the requested analytical method was run and that all QA/QC checks were performed. The laboratory program administrator will provide the Project Manager with QC reports of their external audits if appropriate, which will become part of the project files.

B 8.2 Laboratory Data Deliverables

The laboratory data reports will consist of data packages that will contain complete documentation and all raw data to allow independent data verification and validation of analytical results from laboratory bench sheets, instrument raw data outputs, chromatograms, and mass spectra. Each laboratory data report will include the following:

- Case narrative identifying the laboratory analytical batch number. The laboratory manager or their designee must sign the narrative.

- Matrix and number of samples included.

- Analyses performed and analytical methods used.

- Description of any problems or exceedances of QC criteria and corrective action taken.

- Copy of chain-of-custody forms for all samples included in the analytical batch.

- Tabulated sample analytical results with units, data qualifiers, percent solids, sample weight or volume, dilution factor, laboratory batch and sample number, field sample number, and dates sampled, received, extracted, and analyzed all clearly specified. Surrogate percent recoveries will be included for organic analyses.

- All calibration, quality control, and sample raw data including bench sheets, preparation logs, chromatograms, mass spectra, quantitation reports, and other instrument output data.

- Blank summary results indicating samples associated with each blank.

- Matrix spike/matrix spike duplicates result summaries with calculated percent recovery and relative percent differences.

- Laboratory control sample results, when applicable, with calculated percent recovery.
- Electronically formatted data deliverable (diskette) results.

B 8.3 Electronic Data Management

The USACE and/or its contractors will use a relational database management system to track and report the following:

- Sample station information including location, elevation and field observations such as depth to groundwater as well as monitoring well construction and soil boring details.
- Sample collection information including sample number, station, matrix, type of sample (field, blank, duplicate), date of collection, and sampler.
- Analytical results including concentration, units, qualifier and analytical method.

Laboratory electronic data deliverables will be directly loaded into the database management system, thereby avoiding hand-entry errors. After data quality review is performed, the changes in values or qualifiers will be incorporated into the project database. The project manager will provide additional information such as sampling date, location coordinates, and depth interval from field sampling documentation forms, which are added to the database. A report will be produced and verified against the validated Lab Certificates.

Table B-1
Subsurface Conditions
Field Measurement Methods and Measurement Quality Objectives

Parameter	Analytical Method or Instrument	Required Accuracy and Sensitivity Range	Instrument – Specific Accuracy and Sensitivity Range
Temperature	Thermocouples	2 °C over a range of 0-150 °C	± 1°C over 0-250°C
Temperature	Fiber Optic DTS	2 °C over a range of 0-150 °C	± 0.1°C at100°C[1]
Pressure	Vibrating Wire Pressure Transducer	±0.03 psi	± 0.025 psi
Flow (water)	Pump Stroke Counter	0.0 to 0.32 kg/s	TBD
Flow (vapor)	Valve Position	0.0 to 3.15 kg/s	TBD
	Instrument	0.0 to 0.08 kg/s	TBD
	Flowmeter	0.0 to 0.08 kg/s	TBD

[1] ± 3°C observed at 0°C.

Table B-2
Groundwater or Extracted Liquid
Field Measurement Methods and Measurement Quality Objectives

Parameter	Analytical Method or Instrument	Required Sensitivity	Method Reporting Limit
Condensate Production Rate	Flow meter (TBD)	0.15 gpm	TBD
Groundwater Extraction Rate	Pump stroke counter	1 gpm	N/A
Total Organic Carbon	Shimadzu Model TOC-4100	1 mg/L	1 mg/L
Dissolved Oxygen	CHEMetrics Test Kit (Indigo Carmine-ASTM D 888-87)	1 mg/L	1 mg/L
Carbon Dioxide	CHEMetrics Test Kit (APHA Standard Methods 19th ed method 4500-CO_2 C (1995))	10 mg/L	10 mg/L
Temperature	Thermocouples (Type K)	+/- 1 °C	N/A
Temperature	On-site Field Instrument	+/- 1 °C	N/A
Mass Flow	Manual Reading	+/- 0.1 kg/s	N/A
Pressure	Ashcroft Process Gauge	+/- 2 kPa	N/A
Turbidity	Hach 2100 P		N/A
pH	QED MP 20 Flow Cell	+/- 0.2 units	N/A
Specific Conductance	QED MP 20 Flow Cell		N/A
Water Level Elevation	Slope Indicator Water Level Probe	+/- 0.01 ft	N/A
Interface Level Elev.	Onsite Interface Probe	+/- 0.01 m	N/A

Table B-3
Vapor (Non-Condensable Gases)
Field Measurement Methods and Measurement Quality Objectives

Parameter	Analytical Method or Instrument	Required Sensitivity	Method Reporting Limit
Temperature	Thermocouples (Type K)	+/- 1 °C	N/A
Volumetric Flow	Insertion Gas Mass Flow Meter	+/- 0.01 m^3/s	N/A
Pressure	Ashcroft Process Gauge	+/- 2 kPa	N/A

Table B-4 Recovered NAPL Field Measurement Methods and Measurement Quality Objectives			
Parameter	**Analytical Method or Instrument**	**Required Sensitivity**	**Method Reporting Limit**
Height of NAPL	Continuous Readout on Vessel	+/- 0.25 m	N/A

Table B-5 Noise Field Measurement Methods and Measurement Quality Objectives			
Parameter	**Analytical Method or Instrument**	**Required Sensitivity**	**Method Reporting Limit**
Environmental Noise Level	Type I or Type II sound level meter	± 1 dBA for Type I ± 2 dBA for Type II	N/A

Table B-6 Meteorological Monitoring Field Measurement Methods and Measurement Quality Objectives			
Parameter	**Analytical Method or Instrument**	**Required Sensitivity**	**Method Reporting Limit**
Temperature	Oregon Scientific Model WM-918	+ 2 degrees F from 32 to 104 deg. F + 4 deg. from -40 to 32 deg. F	-40 to 104 degrees F
Wind Speed	Oregon Scientific Model WM-918	+ 1 m/sec or 10% over 10 MPH	0 to 125 MPH (0 – 55 m/s)
Wind Direction	Oregon Scientific Model WM-918	+ 8 degrees	0 to 360 degrees
Barometric Pressure	Oregon Scientific Model WM-918	+ 0.21 inches Hg (+ 7 millibars)	TBD
Daily Precipitation	Oregon Scientific Model WM-918	+ 5%	0.6 to 394 inches

Table B-7
GWTP Process Samples, GWTP Final Effluent, Extracted Liquids, and Site Groundwater
On-Site GWTP Laboratory Analytical Methods and Measurement Quality Objectives

Target Analyte	Analytical Method	Required Sensitivity	Method Reporting Limit	Accuracy Goal	Precision Goal
Ammonia as Nitrogen (NH_3)	EPA 350.1	< 1 mg/L	0.1 mg/L	75-125	±25
Chemical Oxygen Demand (total)	EPA 410.1	< 1 mg/L	10 mg/L	75-125	±25
Chemical Oxygen Demand (soluble)	EPA 410.1	< 1 mg/L	10 mg/L	75-125	±25
Orthophosphate, dissolved	EPA 365.3	< 1 mg/L	0.1 mg/L	75-125	±25
Total Suspended Solids	EPA 160.2	± 1 mg/L	4 mg/L	75-125	±25
Volatile Suspended Solids	STD Method 2540 E	± 1 mg/L	4 mg/L	75-125	±25

Table B-8
GWTP Process Samples, GWTP Final Effluent, and Site Groundwater
STL (SCS Contractor) Analytical Methods and Measurement Quality Objectives

Target Analyte	Laboratory	Method	Required Sensitivity	Method Reporting Limit	Accuracy Goal	Precision Goal
Alkalinity	STL	EPA 310.1	1.0 mg/L	1.0 mg/L	75-125	±25
Total Organic Carbon	STL	EPA 415.1	0.10 %	0.1 %	75-125	±25
Chloride	STL	EPA 300	1.0 mg/L	1.0 mg/L	75-125	±25
Metals (total) - calcium - magnesium - manganese - potassium - sodium	STL	SW-846 6010	 0.25 mg/L 0.15 mg/L 0.01 mg/L 10 mg/L 2.5 mg/L	 0.25 mg/L 0.15 mg/L 0.01 mg/L 0.25 mg/L 1.0 mg/L	75-125	+25
Nitrate/Nitrite	STL	EPA 352.2	0.1 mg/L	0.1 mg/L	75-125	±25
Sulfate	STL	EPA 300	5.0 mg/L	5 mg/L	75-125	±25
Sulfide	STL	EPA 376.1, 2	5.0 mg/L	5 mg/L	75-125	±25

Table B-9 GWTP Process Samples CLP Laboratory Analytical Methods and Measurement Quality Objectives						
Target Analyte	**Laboratory**	**Method**	**Required Sensitivity**	**Method Quantitation Limit**	**Accuracy Goal**	**Precision Goal**
PAHs: Acenaphthene Acenaphthylene Anthracene Benzo(a)anthracene Benzo(a)pyrene Benzo(a)fluoranthene Benzo(g,h,I)perylene Benzo(k)fluoranthene Chrysene Dibenzo(a,h)anthracene Fluoranthene Fluorene Indeno(1,2,3)pyrene Naphthalene Phenanthrene Pyrene	CLP	OLM04.2	10 µg/L	10 µg/L	65-135	±35
PCP	CLP	OLM04.2	25 µg/L	25 µg/L	65-135	±35

Table B-10
GWTP Process Samples, GWTP Final Effluent, and Site Groundwater
EPA Region 10 Laboratory Analytical Methods and Measurement Quality Objectives

Target Analyte	Laboratory	Method	Required Sensitivity	Method Reporting Limit	Accuracy Goal	Precision Goal
PAHs: Acenaphthene Acenaphthylene Anthracene Benzo(a)anthracene Benzo(a)pyrene Benzo(a)fluoranthene Benzo(g,h,I)perylene Benzo(k)fluoranthene Chrysene Dibenzo(a,h)anthracene Fluoranthene Fluorene Indeno(1,2,3)pyrene Naphthalene Phenanthrene Pyrene	EPA Region 10	SW-846 Method 8270C (with SIM on non-detects)	1 µg/L	1 µg/L	65-135	±35
PCP	EPA Region 10	SW-846 Method 8270C (with SIM on non-detects)	0.1 µg/L	0.1 µg/L	65-135	±35
Semivolatile Organics (with TICs)	EPA Region 10	SW-846 Method 8270C	1 µg/L	1 µg/L	65-135	±35
Oil and Grease	EPA Region 10	SW-846 1664	1 mg/L	1 mg/L	65-135	±35
Petroleum Hydrocarbons	EPA Region 10	NWTPH -Dx	0.01 mg/L	0.25 mg/L	65-135	±35
Total Dissolved Solids	EPA Region 10	EPA160 .1	NA	10 mg/L	75-125	±25
Total Suspended Solids	EPA Region 10	EPA 160.2	NA	4 mg/L	75-125	±25

Table B-11
GWTP Final Effluent
Northwestern Aquatic Sciences (SCS Contractor) Laboratory Biomonitoring Toxicity Tests[a] Analytical Methods and Measurement Quality Objectives

Criteria Type	Inland Silversides	Bivalve
Control Response	Control survival must be ≥90 percent at the termination of the test.	The mean survival of normal larvae must be ≥70 percent for oysters (or ≥50 percent for mussels) and the percent abnormal must be 10 percent for oysters (and <10 percent for mussels).
pH	pH must be adjusted to 8.0.	pH must be <6 and <9 for both species (not to be adjusted).
Dissolved Oxygen	Dissolved oxygen concentration must be ≥60 percent of saturation in all test vessels at the termination of the test.	Dissolved oxygen concentration must be greater than or equal to 60 percent of saturation at test initiation in all test vessels.
Temperature	Temperature must be 20 ±1°C throughout the test interval.	Temperature must be 20 ±1°C for oysters and 18 ± 1°C for mussels throughout the test interval.
Reference Toxicants	Response to reference toxicant from concurrent testing must be acceptable. Reference toxicant is copper sulfate.	Response to reference toxicant from concurrent testing must be acceptable. Reference toxicant is cadmium chloride.

[a]Established toxicity test criteria are included as part of the test protocols.

Table B-12 Non-Condensable Gases STL (SCS Contractor) Analytical Methods and Measurement Quality Objectives					
Target Analyte	**Analytical Method**	**Required Sensitivity**	**Method Reporting Limit**	**Accuracy Goal**	**Precision Goal**
CO_2/O_2	ASTM D1946	O_2 = 0.2 mg/m^3 CO_2 = 1.8 mg/m^3	0.1 %	75-125	±25
PCP	TO-13A; SW-846 Method 8270C	0.5 mg/m^3	0.00035 ug/m^3	±30%.	±30%.
PAHs: Benzo(a)anthracene Benzo(a)pyrene Benzo(b)fluoranthene Benzo(k)fluoranthene Chrysene Dibenzo(a,h)anthracene Indeno(1,2,3)pyrene	TO-13A; SW-846 Method 8270C	0.2 mg/m^3	0.00035 ug/m^3	±30%.	±30%.
PAHs: Naphthalene	OSHA 58; SW-846 Method 8270C	50 mg/m^3	0.00035 ug/m^3	±30%.	±30%.
Total Hydrocarbons	EPA Method 25 C Modified	TBD	TBD	TBD	TBD

Table B-13 Air Monitoring Air Toxics, Ltd. (URS Contractor) Analytical Methods and Measurement Quality Objectives					
Target Analyte	**Analytical Method**	**Required Sensitivity**	**Method Reporting Limit**	**Accuracy Goal**	**Precision Goal**
Particulate Matter (PM_{10})	TO-4A	50/150 ug/m^3	TBD	TBD	TBD
PCP	TO-13A; SW-846 Method 8270C	0.33 ug/m^3	0.00035 ug/m^3	±30%.	±30%.
PAHs: Benzo(a)anthracene Benzo(a)pyrene Benzo(b)fluoranthene Benzo(k)fluoranthene Chrysene Dibenzo(a,h)anthracene Indeno(1,2,3)pyrene	TO-13A; SW-846 Method 8270C	0.00048 ug/m^3	0.00035 ug/m^3	±30%.	±30%.
PAHs: Naphthalene	TO-13A; SW-846 Method 8270C	170 ug/m^3	0.00035 ug/m^3	±30%.	±30%.

Table B-14
Boiler Emissions
URS Contractor Laboratories Analytical Methods and Measurement Quality Objectives

Target Analyte	Laboratory	Analytical Method	Required Sensitivity	Method Reporting Limit	Accuracy Goal	Precision Goal
Dioxin/Furans	STL	SW-846 Method 8290	See FSP Sec. 2.4.5	15 – 150 picograms	40 – 135%	< 50%
Volatile Organics	Air Toxics, Ltd.	SW-846 Method 5041A/8260B	See FSP Sec. 2.4.5	10 – 50 nanograms	50 – 150%	< 50%
Semivolatile Organics	STL	SW-846 Method 8270C	See FSP Sec. 2.4.5	10 – 100 micrograms	50 – 150%	< 50%
Total Hydrocarbons	URS or Air Toxics, Ltd.	FID (CEM)or GC (TO-12)	See FSP Sec. 2.4.5	1 ppm or 10 ppbv as heptane or propane	TBD	TBD
PAHs	STL	California Air Resources Board (CARB 429)	See FSP Sec. 2.4.5	10 – 100 micrograms	40 – 120%	< 50%
Hydrogen Chloride and Chlorine	STL	SW-846 Method 9057	See FSP Sec. 2.4.5	5 – 20 micrograms	80 – 120%	< 15%
Particle Size	URS	Gravimetric by URS SOP	See FSP Sec. 2.4.5	1 milligram	NA	NA

Table B-15
Granular Activated Carbon (GAC), Supersand Filter (SSF) and Bioreactor Sludge
EPA Region 10 Laboratory or Waste Disposal Contractor Laboratory Analytical Methods and Measurement Quality Objectives

Target Analyte	Laboratory	Analytical Method	Required Sensitivity	Method Reporting Limit	Accuracy Goal	Precision Goal
PAHs: Acenaphthene, Anthracene, Benzo(a)anthracene, Benzo(a)pyrene, Chrysene, Fluorene, Indeno(1,2,3-cd)pyrene	To Be Determined	SW-846 Method 8270C	3.4 mg / kg	To Be Determined	To Be Determined	To Be Determined
PAHs: Naphthalene, Phenanthrene	To Be Determined	SW-846 Method 8270C	5.6 mg / kg	To Be Determined	To Be Determined	To Be Determined
PAHs: Benzo(b)fluoranthene, Benzo(k)fluoranthene	To Be Determined	SW-846 Method 8270C	6.8 mg / kg	To Be Determined	To Be Determined	To Be Determined
PAHs: Pyrene, Dibenz(a,h)anthracene	To Be Determined	SW-846 Method 8270C	8.2 mg / kg	To Be Determined	To Be Determined	To Be Determined

PCP	To Be Determined	SW-846 Method 8270C	7.4 mg / kg	To Be Determined	To Be Determined	To Be Determined
Dioxin / Furans	To Be Determined	SW-846 Method 8270C	0.001 mg / kg	To Be Determined	To Be Determined	To Be Determined
TCLP (volatiles, semivolatiles, pesticides, and herbicides)	To Be Determined	SW-846 Methods: 1311 (8260B, 8270C, 8081, and 8151)	Wide range, see RCRA code for specific compounds and sensitivities	To Be Determined	To Be Determined	To Be Determined

Table B-16
GWTP Process Samples, GWTP Final Effluent, and Site Groundwater
Field Quality Control Sample Frequency

Target Analyte	Rinsate/Field Blanks	Field Duplicates	MS/MS Duplicate
PAHs	Not Applicable	1 every 4 weeks for effluent and 1/groundwater event	1 every 4 weeks for effluent and 1/groundwater event
PCP	Not Applicable	1 every 4 weeks for effluent and 1/groundwater event	1 every 4 weeks for effluent and 1/groundwater event
Semivolatile Organics (joint observation well locations only)	Not Applicable	One per sampling round	One per sampling round
Petroleum Hydrocarbons	Not Applicable	Not Applicable	Not Applicable
Oil and Grease	Not Applicable	Not Applicable	Not Applicable
Total Organic Carbon	Not Applicable	1/groundwater event	Not Applicable
Alkalinity	Not Applicable	1/groundwater event	Not Applicable
Ammonia as Nitrogen (NH_3)	Not Applicable	Not Applicable	Not Applicable
Chemical Oxygen Demand (total)	Not Applicable	Not Applicable	Not Applicable
Chemical Oxygen Demand (soluble)	Not Applicable	Not Applicable	Not Applicable
Chloride	Not Applicable	1/groundwater event	Not Applicable
Metals (total)	Not Applicable	1/groundwater event	Not Applicable
Nitrate/Nitrite	Not Applicable	1/groundwater event	Not Applicable
Orthophosphate, dissolved	Not Applicable	Not Applicable	Not Applicable
Sulfate	Not Applicable	1/groundwater event	Not Applicable
Sulfide	Not Applicable	1/groundwater event	Not Applicable
Total Dissolved Solids	Not Applicable	1 every 4 weeks for effluent	Not Applicable
Total Suspended Solids	Not Applicable	1 every 4 weeks for effluent	Not Applicable
Volatile Suspended Solids	Not Applicable	Not Applicable	Not Applicable

Target Analyte	Rinsate/Field Blanks	Field Duplicates	MS/MS Duplicate
Toxicity Test – Inland Silversides	Not Applicable	Not Applicable	Not Applicable
Toxicity Test - Bivalve	Not Applicable	Not Applicable	Not Applicable

Table B-17
Non-Condensable Gases
Field Quality Control Sample Frequency

Target Analyte	Rinsate/Field Blanks	Field Duplicates	MS/MS Duplicate
CO_2/O_2	Not Applicable	Not Applicable	5 percent or 1/per batch
PCP	Not Applicable	Not Applicable	5 percent or 1/per batch
PAHs	Not Applicable	Not Applicable	5 percent or 1/per batch
Naphthalene	Not Applicable	Not Applicable	5 percent or 1/per batch
Total Hydrocarbons	Not Applicable	Not Applicable	5 percent or 1/per batch

Table B-18
Air Monitoring
Field Quality Control Sample Frequency

Target Analyte	Field Blanks	Method Blanks	Field Duplicates	Surrogates
PCP	2 per event	2 per event	None	All samples
PAHs	2 per event	2 per event	None	All samples
Naphthalene	2 per event	2 per event	None	All samples

Table B-19
Boiler Emissions
Field Quality Control Sample Frequency

Target Analyte	Field Blanks	Field Duplicates	Surrogates	MS/MS Duplicates
Dioxin/Furans	1 per event[1]	None	All samples	Per Method
PAHs	1 per event	None	All samples	Per Method
Volatile Organics	1 per each day of sampling (3)	None	All samples	Per Method
Semivolatile Organics	1 per event	None	All samples	Per Method
Total Hydrocarbons	1 per event	None	NA	NA
Hydrogen Chloride and Chlorine	1 per event	None	None	Per Method
Particle Size	None	None	NA	NA
[1]Only 1 event or testing condition is being performed.				

Table B-20
Granular Activated Carbon (GAC), Supersand Filter (SSF) and Bioreactor Sludge
Field Quality Control Sample Frequency

Target Analyte	Rinsate/Field Blanks	Field Duplicates	MS/MS Duplicate
PAHs	Not Applicable	Not Applicable	5 percent or 1/per batch
PCP	Not Applicable	Not Applicable	5 percent or 1/per batch
Dioxin/Furans	Not Applicable	Not Applicable	5 percent or 1/per batch
TCLP Volatile Organics	Not Applicable	Not Applicable	5 percent or 1/per batch
TCLP Semivolatile Organics	Not Applicable	Not Applicable	5 percent or 1/per batch
TCLP Pesticides	Not Applicable	Not Applicable	5 percent or 1/per batch
TCLP Herbicides	Not Applicable	Not Applicable	5 percent or 1/per batch

C ASSESSMENT AND OVERSIGHT

C 1.0 ASSESSMENTS AND RESPONSE ACTIONS

C 1.1 Assessments

Assessments will be used to increase the user's understanding of the activity being assessed and to provide a basis for improving that activity. Assessments may be conducted by the EPA, USACE or independent subcontractors. All assessments will be planned and documented according to the project requirements.

Performance and systems audits may be conducted to determine whether:

- The QA program has been documented in accordance with specified requirements
- The documented program has been implemented
- Any nonconformances were identified and corrective action or identified deficiencies was implemented

The Project Manager will be responsible for initiating audits, selecting the audit team, and overseeing audit implementation. The Project Manager is responsible for supervising and checking that samples are collected and handled in accordance with this plan and that documentation of work is adequate and complete. The Project Manager is also responsible for overseeing that the project performance satisfies the QA objectives as set forth in this QAPP.

Reports and technical correspondence will be peer reviewed by qualified individuals before being finalized. Copies of all audit reports will be submitted to EPA for review.

Performance Audits

Performance audits are used to determine the status and effectiveness of both field and laboratory measurement systems and to provide a quantitative measure of the quality of data generated. For laboratories, this involves the use of standard reference samples or performance evaluation samples. These samples have known concentrations of constituents that are analyzed as unknowns in the laboratory. Results of the laboratory analyses are calculated and compared for accuracy against the known concentrations of the samples and evaluated in relation to the project measurement quality objectives. PE samples will be routinely submitted to the off-site analytical laboratories at the rates specified in the FSP. .Field performance will be evaluated using field duplicates.

Technical Systems Audits

Technical system audits are used to confirm the adequacy of the data collection (field operation) and data generation (laboratory operation) systems. The on-site audits are conducted to determine whether the project-specific plans and field and laboratory SOPs are being properly implemented. A system audit may cover the field or laboratory portions of the project. The

Project Manager may request that a system audit of the field or laboratory operations be performed.

C 1.2 Response Actions

The ultimate responsibility for maintaining quality throughout the project rests with the Project Manager. The day-to-day responsibility for assuring the quality of field and laboratory data rests with the field manager and the laboratory program administrator, respectively.

Any nonconformance with the established QC procedures will be expeditiously identified and controlled. Where procedures are not in compliance with the established protocol, corrective actions will be taken immediately. Subsequent work that depends on the nonconforming activity will not be performed until the identified nonconformance is corrected.

Field Corrective Action

The field manager will review the procedures being implemented in the field for consistency with the established protocols. Sample collection, preservation, labeling, etc., will be checked for completeness. Where procedures are not strictly in compliance with the established protocol, the deviations will be documented and reported to the Project Manager. Corrective actions will be defined by the field manager and documented as appropriate. Upon implementation of the corrective action, the field manager will provide the Project Manager with a written memo documenting field implementation. The memo will become part of the project file.

Laboratory Corrective Action

The laboratory QA data reviewer will review the data generated to ensure that all QC samples have been run as specified in the protocol. Recoveries of LCS and MS samples for consistency with method accuracy, and RPD for laboratory duplicate samples for consistency with method precision, will be evaluated against the control limits established for this project.

Laboratory personnel will be alerted that corrective actions are necessary if any of the following occur:

- The QC data are outside the warning or acceptance windows established for precision and accuracy. The laboratory project manager will contact the laboratory QA manager to discuss out-of-control limit data sets. If the analyses cannot produce data sets that are within control limits, the project manager will be notified within 48 hours of any analysis that fails to meet the measurement quality objectives specified in this QAPP.

- Blanks contain contaminants at concentrations above the levels specified in the laboratory QA plan for any target compound.

- Undesirable trends are detected in matrix spike or LCS recoveries, or RPD between laboratory duplicates.

- Unusual changes in detection limits are observed.

- Deficiencies are detected by the laboratory QA manager during internal or external audits, or from the results of performance evaluation samples.

If any nonconformances in analytical methodologies or quality control sample results are identified by the analyst, corrective actions will be implemented immediately. Specific corrective actions are outlined in each laboratory SOP. Corrective action procedures will be handled initially at the bench level by the analyst, who will review the preparation or extraction procedure for possible errors, check the instrument calibration, spike and calibration mixes, instrument sensitivity, etc. The analyst will immediately notify his/her supervisor of the identified problem and the investigation that is being conducted. If the problem persists or cannot be identified, the matter will be referred to the laboratory supervisor and laboratory QA manager for further investigation. Once resolved, full documentation of the corrective action procedure will be filed by the laboratory QA manager, and if data are affected, the project manager will be provided a corrective action memo for inclusion into the project file.

Corrective action may include, but will not be limited to the following:

- Reanalyzing suspect samples if holding time criteria permit
- Resampling and analyzing new samples
- Retrieving the archived sample for analysis
- Evaluating and amending sampling and/or analytical procedures
- Accepting data with an acknowledged level of uncertainty
- Recalibrating analytical instruments
- Evaluating and attempting to identify limitations of the data

Data deemed unacceptable following the implementation of the required corrective action measures will be rejected during data evaluation and follow-up corrective actions will be explored.

Corrective Actions Following Data Evaluation

Field and laboratory data generated for this project will be reviewed to ensure that all project objectives are met. If any nonconformances are found in the field procedures, sample collection procedures, field documentation procedures, laboratory analytical and documentation procedures, and data evaluation and quality review procedures, the impact of those nonconformances on the overall project objectives will be assessed. Appropriate actions, including resampling and reanalysis, may be recommended to the Project Manager so that the project objectives can be accomplished.

C 2.0 REPORTS TO MANAGEMENT

Field activities will be documented in draft and final versions in technical memorandum format. The memorandum will include a discussion of field work and results of all chemical tests. Field notes, calculations, field forms, analysis results and resultant interpretations will be included. This memorandum will also include an analysis of the results in relation to the purpose and objectives of the field activities. A review conference will be held to discuss the memorandum and recommendations. Formal, written responses to EPA and project team review comments will be prepared and incorporated into the final reports as necessary.

D DATA VALIDATION AND USABILITY

D 1.0 DATA QUALITY REVIEW

The purpose of the data quality review is to eliminate unacceptable analytical data and to designate a data qualifier for any data quality limitation discovered. A formal data quality review will be performed by the EPA, the USACE, or subcontractors and will include a review of laboratory performance criteria and sample-specific criteria. The reviewer will determine whether the measurement quality objectives have been met, and will calculate the data completeness for the project. Data validation will be performed on ten (10) percent of the analytical data generated from the contractor laboratory. The government will be responsible for validating all analytical data generated by EPA laboratories (or their subcontracting laboratories). Under the existing contract, SCS will be responsible for validating all analytical data generated by their subcontractors. USACE will be responsible for validating all analytical data generated by other contractors (i.e., air monitoring). Field measurement data will not be subject to a formal data quality review.

Data quality review consists of a review of the data summary forms that are generated for a set of data. At a minimum, chain-of-custody records, the case narrative, and the summary results for project samples and quality control samples are reviewed. The data are reviewed in accordance with the criteria contained in EPA guidance documents modified for the analytical method used. Data will be reviewed in accordance with EPA's Contract Laboratory Program National Functional Guidelines for Organic (and Inorganic) Data Review (USEPA 1999, 2002).

The data quality review will include verification of the following:

- Compliance with the QAPP
- Proper sample collection and handling procedures
- Holding times
- Field QC results
- Instrument calibration verification
- Laboratory blank analysis
- Detection and reporting limits
- Laboratory duplicate precision
- Matrix spike percent recoveries
- Data completeness and format
- Data qualifiers assigned by the laboratory

Qualifiers will be added to data during the review as necessary. Qualifiers applied to the data as a result of the review will be limited to:

- U The analyte was analyzed for but was not detected above the reporting limit.
- J The analyte was positively identified; the associated numerical value is an estimate of the concentration of the analyte in the sample.
- UJ The analyte was not detected above the sample reporting limit. However, the reporting limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.
- R The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.

Results of the QA review will be included in a data quality review report that will provide a basis for meaningful interpretation of the data quality and evaluate the need for corrective actions and/or comprehensive data validation. These reports will be used to generate the data quality assessment report.

D 2.0 RECONCILIATION WITH USER REQUIREMENTS

After the field work, chemical analyses, and data quality reviews have been completed, a final data quality assessment report will be prepared. In this report, all data generated for this project will be reconciled with the project objectives. The report will include an assessment of the overall usability of the data and describe any limitations on its use, and will summarize any audit information, indicating any corrective actions taken. The data quality assessment report will include an evaluation of overall precision, accuracy, completeness, representativeness, and comparability, using the data quality review reports as a base.

REFERENCES

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———. 1997b. Feasibility Study (FS) Report for the Wyckoff Soil and Groundwater Operable Units, Wyckoff/Eagle Harbor Superfund Site, Bainbridge Island, Washington. Prepared for U.S. Environmental Protection Agency, Region 10, Seattle, Washington. October 17, 1997.

———. 1994. Final Focused RI/FS for the Groundwater Operable Unit for the Wyckoff/Eagle Harbor Superfund Site, Bainbridge Island, Washington. Prepared for U.S. Environmental Protection Agency, Region 10, Seattle, Washington. July 13, 1994.

USACE. 2001. Final Design Analysis, Thermal Remediation Pilot Study, Soils and Groundwater Units, Wyckoff/Eagle Harbor Superfund Site, Bainbridge Island, Washington. August 31.

U.S. Environmental Protection Agency. 1999. USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review. EPA-540/R-99-008 (PB99-963506). October 1999.

———. 2000. Record of Decision, Wyckoff/Eagle Harbor Superfund Site, Soil and Groundwater Operable Units, Bainbridge Island, Washington. Environmental Protection Agency, Region 10, Seattle, Washington. February 2000.

———. 2002. USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review. EPA 540-R-01-008. July 2002.

APPENDIX B

APPENDIX B

Resumes of Key Personnel

OMI

CLIFFORD G. LEEPER

Operations Specialist

EDUCATION

Chemistry/Zoology (b) (6)

(b) (6)

Numerous Job-Related Short Schools

CERTIFICATIONS

ABC Grade IV Wastewater Operator

Oregon Grade IV Wastewater Operator, Wyoming Wastewater Operator Grade IV

Wyoming Grade 1 Wastewater Collections

Oregon Grade I Wastewater Collections

Indiana Class D Industrial Wastewater

Commercial Drivers License with Tank and Hazmat Endorsement

40-Hour Hazmat and Other OSHA Training Courses

PROFILE

Mr. Leeper has more than 21 years of environmental experience including chemical and biological lab analysis, environmental quality control sampling, and maintenance, municipal, industrial and hazardous wastewater operations, and groundwater site remediation. He has performed sampling, analysis, and interpretation of results for air emissions, groundwater, and wastewater compliance with applicable regulations. He also has familiarity and experience with meeting reporting requirements for local, state and Environmental Protection Agency permits. Mr. Leeper also meets all hazardous waste training requirements and protocols as well as numerous short schools on operational, maintenance, and laboratory subjects.

EXPERIENCE

Project Manager -Operations/Safety Manager
Operations Management International, Inc., Bainbridge Island, Washington

- Mr. Leeper serves as Project Manager/Operations Site Safety Manager for an advanced hazardous waste ground water treatment facility. This facility is located in a pristine ecological location. His responsibilities include budgeting, operations, safety, and supervising a staff in the operation of the facility. Mr. Leeper interfaces with the Environmental Protection Agency/US Army Corps. Of Engineers in meeting weekly permit requirements while maintaining normal operations. Hazardous waste generated at this facility is stored and incinerated off site. During tenure at the site OMI's gold safety award was achieved as well as laboratory compliance with designated company goals.

Operations Supervisor
Operations Management International, Inc.
Rockport, Indiana

CLIFFORD G. LEEPER

Operations Specialist

(b) (6)

[redacted]

OMI

CLIFFORD G. LEEPER

Operations Specialist

(b) (6)

[redacted]

OMI

CLIFFORD G. LEEPER

Operations Specialist

(b) (6)

[redacted]

DAVID E. ROBERSON, CHMM

SCS ENGINEERS

Education

B.S., (b) (6) niversity, Bacteriology and Public Health

M.S., Environmental Science - Water Resources

Professional Registrations

Certified Hazardous Materials Manager (CHMM (b) (6) Professional Certification Board, Institute of Hazardous Materials Management (b) (6)

Professional Affiliations

Past President/Director /Co-founder - Pacific NW Chapter of the Academy of Hazardous Materials Management

King County Waste Information Network Advisory Board

Institute of Hazardous Materials Management

Professional Experience

Mr. Roberson began working with SCS in (b) (6) and has over twenty years of experience providing innovative environmental solutions. His experience, coupled with his interdisciplinary education and training in environmental science, bacteriology and public health, chemistry, toxicology, and water resource management, provides him with the tools necessary to address a wide range of environmental and regulatory issues.

Mr. Roberson is one of SCS' most experienced project managers. He has successfully managed contaminated site investigation and cleanup projects involving dozens of people, multiple subcontractors, and cleanup costs ranging from $10,000 to over $100 million.

General

Mr. Roberson has provided environmental science and hazardous materials management consulting for both private industry and various governmental organizations in the US and overseas. He has directed, managed or been the principal investigator on numerous projects in each of the following topic areas.

- Hazardous Waste site investigation and remediation
- Operation, Maintenance, and Monitoring of Contaminated Groundwater Treatment Systems
- Human Health Risk Assessment
- Worker health and safety planning and management
- Environmental Chemistry
- Environmental Management Systems Planning and Development
- Pollution Prevention and Waste minimization studies
- Regulatory compliance assessment and permitting

Selected project experience includes:

- Project Director for a multi-million dollar remedial investigation, feasibility study, and remedial design for the residential and commercial redevelopment of the Pacific Place site, a 200-acre contaminated industrial waterfront area in Vancouver, British Columbia. Contaminants at this site included chlorinated hydrocarbons and trace metals from wood treating operations, PAHs from historic coal tar pits and coal gasification plants, as well as trace metals and other organic contaminants from rail yard operations, boat building, lumber mills, and other light industry.

(b) (6)

[redacted]

JOSEPH HARRINGTON

SCS ENGINEERS

Education

B.S., Mechanical Engineering, (b) (6) [redacted]

Professional Experience

Mr. Harrington joined SCS in (b) (6) [redacted] He has over ten years of experience with a focus in the design of solid waste handling facilities, including: transfer stations and material recovery facilities, recycling facilities, and moderate risk waste facilities. He also conducts landfill gas flare operations, and solid waste and landfill gas to energy studies.

His work has included: waste characterization and reduction, site planning, systems/process design, equipment selection, heating ventilating and air conditioning (HVAC) design, design of fire protection systems, landfill gas generation computer modeling, and design of landfill gas extraction systems. Additional experience includes preparation of contract drawings and specifications; siting, construction observation, permitting and public information, and landfill construction quality assurance.

Representative Project Experience:

- Wyckoff/Eagle Harbor Superfund site Existing Treatment Plant O&M, Project Manager
- Cedar Hills Landfill Support Facilities Improvement Project – Project Engineer
- Weber County Transfer Station – Project Engineer
- University of Washington Motor Pool and Vehicle Maintenance Facility – Project Engineer.
- Yakima Transfer Station Siting & Design - Project Engineer
- Factoria Transfer/Recycling Station Siting, Permitting & Design - Project Engineer

Mr. Harrington has received the 40-hour training for "Health and Safety at Hazardous Waste Sites" and annual refresher courses, in compliance 29 CFR 1910.120. Representative project experience follows.

Hazardous Waste Site and Landfill Remediation

- **Wyckoff/Eagle Harbor Superfund Site.** Project Management and supervision for operation and maintenance of a groundwater extraction and treatment system.
- **Vapor Extraction System Design.** Project Engineer for the development and design of a vapor extraction system to remove organics from contaminated soil at the City of Seattle's Charles Street site. Prepared plans and specifications, managed construction, and assisted in system startup and operation.
- **Bio-Landfarm Facility Design.** Project Engineer responsible for the design of a bio landfarm facility for the City of Seattle. The facility was designed to treat 3000 cubic yards of heavily contaminated soil over a six-month period. Collection and reuse of the waste water runoff from the facility was included in the design.

(b) (6)

(b) (6)

[redacted]

APPENDIX C

APPENDIX C

Quality Control Discrepancy Reports
Weekly Quality Control Inspection Log
And Field Forms

EXAMPLE FORMS (SCS ENGINEERS)

WEEKLY QUALITY CONTROL INSPECTION LOG

WEEKLY QUALITY CONTROL INSPECTION LOG			
DATE	LOCATION	ITEMS INSPECTED	RESULTS

If satisfactory, write "Sat", if deficient, include the Quality Control Discrepancy Report with the Weekly Summary.

On behalf of the Contractor, I certify that this report is complete and correct and equipment and material used and work performed during this reporting period is in compliance with the contract requirements to the best of my knowledge, except as noted in this report.

Contractor Quality Control Representative _______________ Date _______________

DEFICIENCY REPORT NO. _________

Contractor: SCS ENGINEERS

Date: _______________ Contract No: DACA67-01-D-1007 T.O. 0003

Location: Wyckoff/Eagle Harbor Superfund Site, Bainbridge Island, Washington

Reference Specifications Paragraph: _______________

Deficiency: _______________

Corrective Action: _______________

Acknowledgment: _______________

CQC Representative & Date _______________ Corps of Engineers Field Representative

Spill Response Incident Report Form

Location: _______________ **Date:** _______________

Person Completing Form: _______________

SPILL DATE: _______________ **TIME:** ______ **(2400 clock)**

Discovered by: ________________

Reported to:__________________ Date:___________ Time:__________

Names of Personnel Responding to Spill: ____________________________

____

____

Weather conditions: __________________________

GENERAL SPILL LOCATION: ___________________________

SPECIFIC SPILL LOCATION: ____________________________

MATERIAL SPILLED: ___________________________________

Quantity: _____________________________ gallons/drums/other_____

How long did discharge continue? ________

Total amount discharged:________________

Discharge rate: ________________________

Material characteristics:

____ Flammable _____Explosive

____ Toxic _____Corrosive

____ Oxidizer _____Other

Brand name/concentration (if available): __________________________

CAUSE/SOURCE OF SPILL

_______ Tank overfill _______Tank leak

_______ Equipment failure _______Vandalism

_______ Accident _______Other

Comments: ____

____

____

Spill Response Incident Report Form (cont.)

DAMAGE/IMPACT and ESTIMATED QUANTITY RELEASED

Onsite or Offsite? __________

_______ Sanitary sewer

_______ Storm sewer

_______ Surface water

_______Vegetation

_______Residential property

_______Wildlife habitat

_______ Groundwater

_______ Commercial property

_______ Air

AGENCIES NOTIFIED: USACE

Date: ________ **Time:**_________

Person contacted: ________________________________

CORRECTIVE ACTION TAKEN

______ Stopped leak

______ Covered/blocked storm drain

______ Used sorbent dam

______ Deployed boom

_______ Closed valve(s)

_______ Constructed dike

________ Overpacked drum/ container

Comments: ____

____

____

CLEANUP ACTION TAKEN:

__________ Used absorbent

__________ Removed soil

__________ Pumped out

__________ Evaporated

__________ Contracted (contractor name): _________________________

__________ Other

__________ Burned

__________ Mopped

__________ Flushed

DISPOSAL METHOD:

_________ Drum overpack

_________ Oil/water separator (to sewer)

___________ Recycled

___________ Reclaimed/Reused

Spill Response Incident Report Form (cont.)

________ Disposal Contractor (contractor name): ________________________

________ Other

INJURIES/EVACUATION: Yes/No

Details:____

____

____

ADDITIONAL INFORMATION:

____

____

____

____

____

____

____

WYCKOFF PROJECT / READINGS AND ROUNDS

	Morning Rounds	Mid-day Rounds	PM Rounds
Operators Intials:			

	Today's Reading
Tank 401 Q	

Date: ____________________

PRODUCTION WELLS ROUNDS

WELL	Target Flow(gpm)	a.m. readings TOTAL Q	(gpm)	am observ	mid-day observ	pm observ	Comments
PW-1							
PW-2							
PW-3							
PW-4							
PW-5							
PW-6							
PW-8							
PW-9							

PLANT READINGS

Location	a.m. Observ.	mid-day Observ	p.m. Observ	Comments
Potable Water				
Decon Pad pumps(auto)				
Auto Dialer (Power on / no alarms)				
Generator (auto)				
Gen Battery Charger (on / grn light)				
Generator hours				
Blower #1 or Blower #2 (hand)				
Sump (empty)				
P-106A & P106B (auto)(alt)				
Depurator Dep-104				
Aerators/Skimmers (on)				
DP-104 (hand) & %	/	/	/	
P-104A or P-104B (auto)				
Actuator Valve 104 (off seat)				
Carbon Vessels				
T-300 Inf. psi				
T-300 Eff. psi				
Sequence (1 or 2)				
T-301 Inf. psi				
T-301 Eff. psi				
Sequence (1 or 2)				
T-302 Inf. psi				
T-302 Eff. psi				
Sequence (1 or 2)				
Van Air (on)				
Van Air Moisture Traps(2) Drained				

1. Normal switch positions for equipment when it is running are shown in parenthesis ( ) next to each peice of equipment has more than one running position or mode availible

WYCKOFF PROJECT / READINGS AND ROUNDS

Location	a.m. Status	mid-day Status	p.m. Status	Comments
Separator T-108 (bubbling at inlet)				
Campbell Air Comp (run or stby)				
Sullair Air Comp (run or stby)				
Sullair Air Comp total hours				
Sullair Air Comp Pressure				
Sullair Air Comp Temperature				
Drn moisture from air receivers				
T-401				
Tank Level - inches				
P-401A or P-401B (manual)				
Flow - gpm (estimate)				
T-402				
Tank Level - inches				
P-402A or P-402B (auto)				
Flow-gpm				
Actuator Valve 402 (off seat)				
Multi-Media Filters				
Intake & Disch pressures (IN/OUT)	/	/	/	
MMF's Differental Pressure				
Backwashed MMF'S (BW) or Pumped Backwash tank(PBW)	☐	☐	☐	
Plant Air Gauge				
Biofilter Level				
P-205A or P-205B (auto)				
Actuator Valve 205 (off seat)				
Aeration Basin				
Clarifier (Level/Clarity in feet)				
Skimmers (on / Skimmimg)				
RAS (air on / indication of flow)				
Digester (air on / bubbling)				
PolyBlend (on / chamber cloudy)				
PolyBlend Flow Meter (in GPH)				
strokes per minute / percent stroke	/	/	/	

COLD WEATHER ITEMS (Temp expected to drop below freezing)

Heat Tracing (ON or OFF)	
Freeze Protection SOP Implemented (YES or NO)	

1. Normal switch positions or indications for equipment when it is operating normally are shown in parenthesis ( ) next to each peice of equipment.

Wyckoff / Eagle Harbor Superfund Site

Date ______________________

SCS Project: 04201030.03

USACE Contract: DACW67-01-D-1007/003

BOILER ROOM DAILY ROUND

	BOILER				DEARATING FEED TANK			AUXILLARY EQUIP		FIELD EFFLUENT		FIELD GAS		FUEL ST	FUEL DAY	Operator's INITIALS
Time	PSI	W/L	STM T	FUEL FLOW	PMP 1/2	PSI	TEMP	M/U 1/2	M/U PSI	PMP 1/2	PSI	VAC	PSI	FT/IN	FT/IN	
0000																
0100																
0200																
0300																
0400																
0500																
0600																
0700																
0800																
0900																
1000																
1100																
1200																
1300																
1400																
1500																
1600																
1700																
1800																
1900																
2000																
2100																
2200																
2300																
2400																

SCS ENGINEERS

EXTRACTION WELL SAMPLING LOG

SITE: Wykoff Pilot Remediation

PROJECT NO: 04201030.03

WELL ID: ____________

SAMPLE TYPE (circle): Grab Composite

SAMPLE CONTAINERS: ____________

GENERAL COMMENTS: ____________

Sample Location

DAILY SAMPLING INFORMATION

DATE	TIME	SITE ID	EPA ID	ANALYTES	SENT TO LAB (Y/N)

Wellhead Observations (color, odor, anomalies, etc)

SAMPLER: ____________ ____________

Printed Name Signature

SCS ENGINEERS

FIELD SAMPLING RECORD

SITE: ____________________ PROJECT NO: ____________________

SAMPLE ID: ____________________ WEATHER: ____________________

DATE: ____________________

Sample Location

MEDIA SAMPLED (circle): Surface/Storm Water Soil/Sediment Gas/Vapor Material

SAMPLE TYPE (circle): Grab Composite

SAMPLE CONTAINERS:

COMMENTS:

FIELD PARAMATERS (if applicable)

TIME								

Observations (color, odor, anomalies, etc)

SAMPLER: ____________________ ____________________

Printed Name Signature

Wyckoff / Eagle Harbor Superfund Site - Readings

Date ___________

Sampler's Name ____________________

Project No. DACW67-02-T-005

WEATHER CONDITIONS

	Time	Temp.	Wind Speed	Wind Direction	Barometric Pressure	Precipitation
Units		deg. F	mph	degrees	inches	inches
Reading						

(Pressure Units - psi, Temperature Units - degress F, Flow Units - ?, Valve Position Units-?)

VAPOR CAP SYSTEM

Sample Location	Reading	Time	Sample Location	Reading	Time	Sample Location	Reading	Time
PG-V-C01A			VP-V-C03A			PG-V-C06B		
PG-V-C01B			PG-V-C04A			VP-V-C06A		
VP-V-C01A			PG-V-C04B			PG-V-C07A		
PG-V-C02A			VP-V-C04A			PG-V-C07B		
PG-V-C02B			PG-V-C05A			VP-V-C07A		
VP-V-C02A			PG-V-C05B			PG-V-C08A		
PG-V-C03A			VP-V-C05A			PG-V-C08B		
PG-V-C03B			PG-V-C06A			VP-V-C08A		

EXTRACTION WELLS

Sample Location	Reading	Time	Sample Location	Reading	Time	Sample Location	Reading	Time
PG-V-E01A			PG-L-E03A			SC-L-E05A		PM
PG-V-E01B			VP-V-E03A			PG-V-E06A		
PG-L-E01A			TG-L-E03A			PG-V-E06B		
VP-V-E01A			SC-L-E03A		AM	PG-L-E06A		
TG-L-E01A			SC-L-E03A		PM	PG-L-E06A		
SC-L-E01A		AM	FM-V-E04A			VP-V-E06A		
SC-L-E01A		PM	TG-L-E04A			VP-V-E06A		
PG-V-E02A			PG-V-E04A			TG-L-E06A		
PG-V-E02B			SC-L-E04A		AM	SC-L-E06A		AM
PG-L-E02A			SC-L-E04A		PM	SC-L-E06A		PM
VP-V-E02A			PG-V-E05A			PG-V-E07A		
TG-L-E02A			PG-V-E05B			PG-V-E07B		
SC-L-E02A		AM	PG-L-E05A			PG-L-E07A		
SC-L-E02A		PM	VP-V-E05A			VP-V-E07A		
PG-V-E03A			TG-L-E05A			TG-L-E07A		
PG-V-E03B			SC-L-E05A		AM	SC-L-E07A		AM
						SC-L-E07A		PM

Wyckoff / Eagle Harbor Superfund Site - Readings

Date ___________

INJECTION WELLS

Sample Location	Reading	Time	Sample Location	Reading	Time	Sample Location	Reading	Time
PG-S-I01A			PG-S-I06B			VP-S-I11A		
PG-S-I01B			VP-S-I06A			PG-S-I12A		
VP-S-I01A			PG-S-I07A			PG-S-I12B		
PG-S-I02A			PG-S-I07B			VP-S-I12A		
PG-S-I02B			VP-S-I07A			PG-S-I13A		
VP-S-I02A			PG-S-I08A			PG-S-I13B		
PG-S-I03A			PG-S-I08B			VP-S-I13A		
PG-S-I03B			VP-S-I08A			PG-S-I14A		
VP-S-I03A			PG-S-I09A			PG-S-I14B		
PG-S-I04A			PG-S-I09B			VP-S-I14A		
PG-S-I04B			VP-S-I09A			PG-S-I15A		
VP-S-I04A			PG-S-I10A			PG-S-I15B		
PG-S-I05A			PG-S-I10B			VP-S-I15A		
PG-S-I05B			VP-S-I10A			PG-S-I16A		
VP-S-I05A			PG-S-I11A			PG-S-I16B		
PG-S-I06A			PG-S-I11B			VP-S-I16A		

Legend

PG - pressure gauge
TG - temperature gauge
FM - flow meter
VP - Valve Position
SC - Pump Stroke Counter

V - vapor extraction line
L - liquid extraction line
S - steam line
C - Vapor cap collection piping

E - Extraction well
I - Injection well
A - First location of that type for the well
B - Second location of that type for the well, etc.

Sampler's Signature ______________________________